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Matsumoto et al.

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(54) **SHEET CONVEYING APPARATUS AND IMAGE FORMING APPARATUS**

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B65H 5/06	(2006.01)
B65H 7/02	(2006.01)

(52) **U.S. Cl.**

CPC ***B65H 5/062*** (2013.01); ***B65H 7/02*** (2013.01); ***B65H 9/166*** (2013.01); *B65H 2404/1441* (2013.01); *B65H 2511/224* (2013.01); *B65H 2515/34* (2013.01); *B65H 2701/1311* (2013.01); *B65H 2701/1313* (2013.01); *B65H 2801/06* (2013.01)

(58) **Field of Classification Search**

CPC B65G 9/166; B65H 5/062; B65H 5/068; B65H 9/16

See application file for complete search history.

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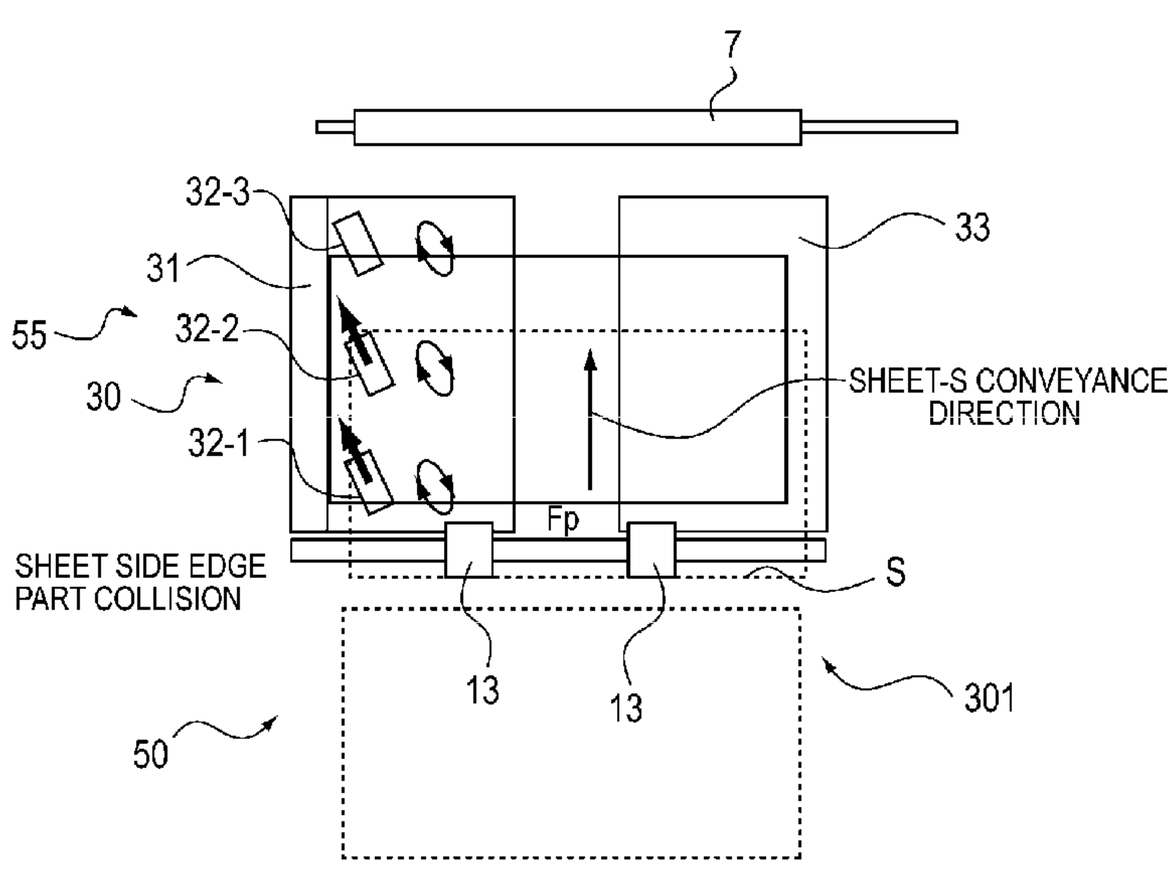
(57) **ABSTRACT**

A sheet conveying apparatus according to the present invention includes: a pair of conveying rollers **13** which nips and conveys a sheet; a reference member **31** which determines the position of a side edge of the sheet along the sheet conveyance direction; a plurality of pairs of skew feeding correcting rollers **32** which nip and convey the sheet conveyed by the pair of conveying rollers **13** and draw the side edge of the sheet to the reference member **31**; and a switching unit which switches the pair of conveying rollers **13** and the pairs of skew feeding correcting rollers **32** between a state of nipping the sheet and a state of nip releasing the sheet, the switching unit releasing the nip of the sheet by the pair of conveying rollers **13** after the conveyed sheet is nipped by at least two of the pairs of skew feeding correcting rollers **32**.

11 Claims, 13 Drawing Sheets



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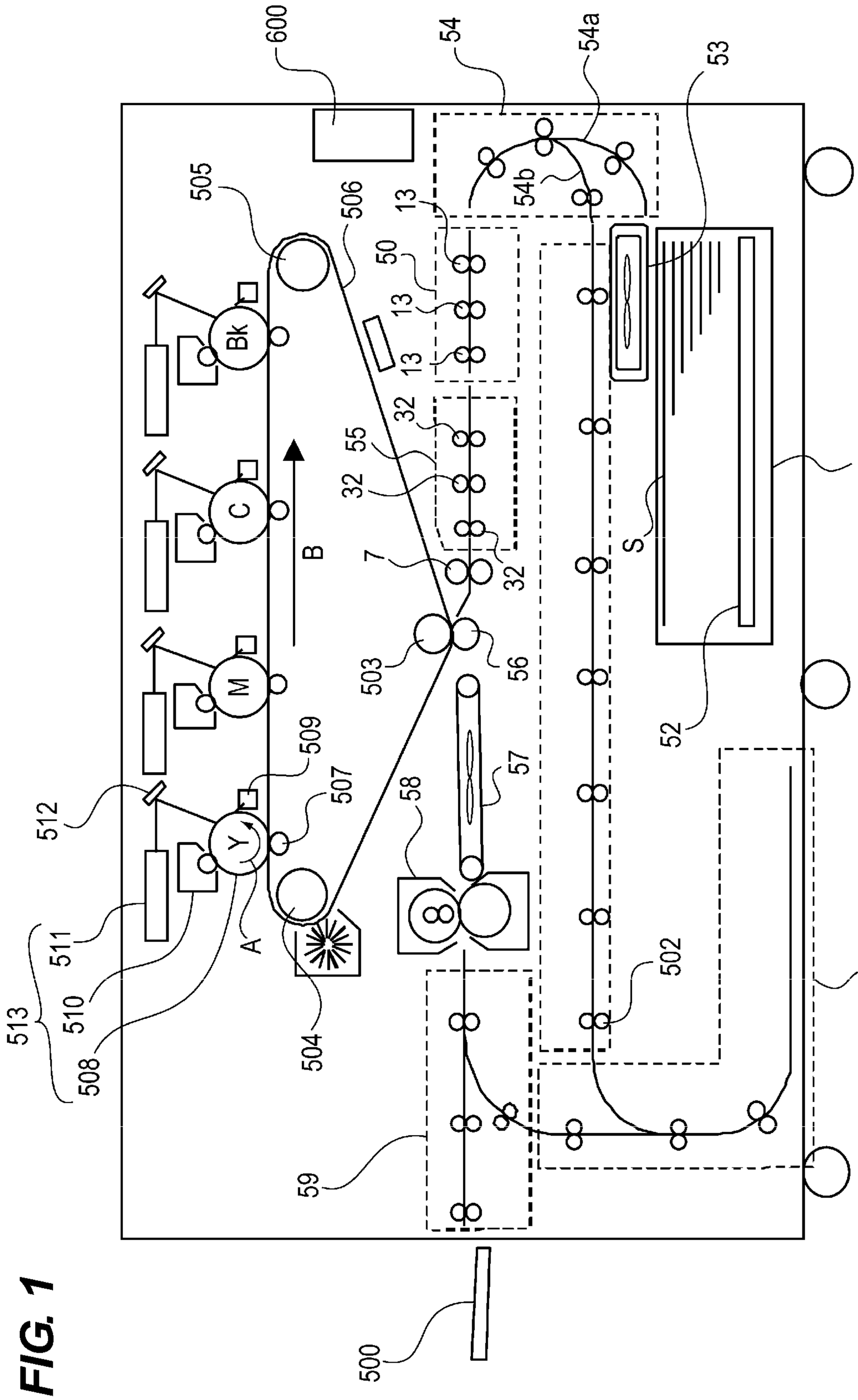

600
54
54a
53
505
506
13
54b
50
13
13
Bk
C
M
Y
B
A
509
507
512
511
510
513
508
504
59
32
55
32
32
7
503
56
58
57
8
S
52
51
502
501
500

FIG. 1

FIG. 2A

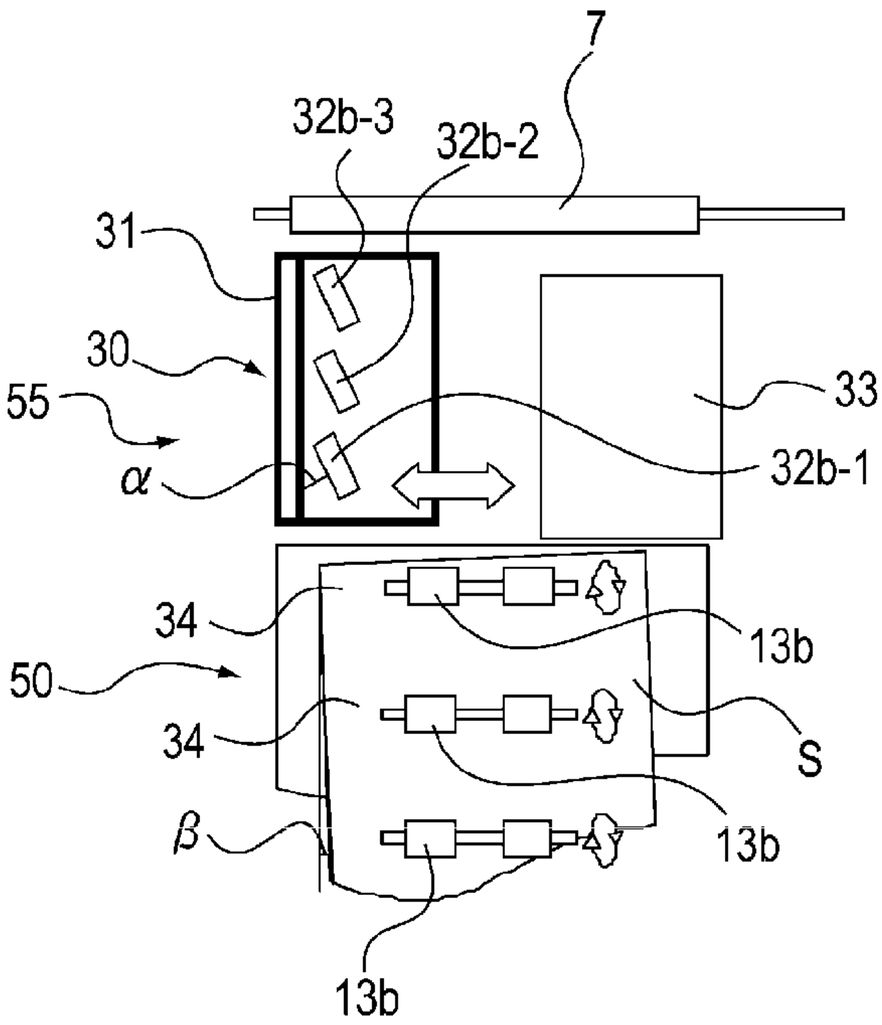


FIG. 2B

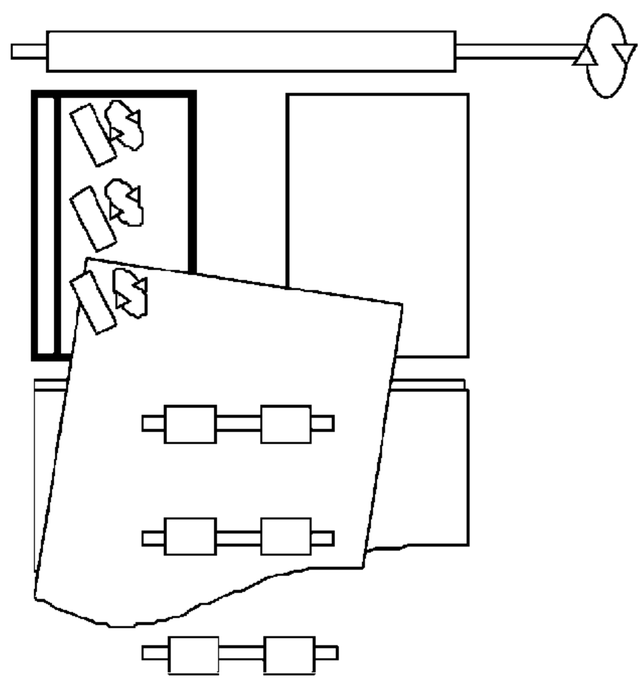


FIG. 2C

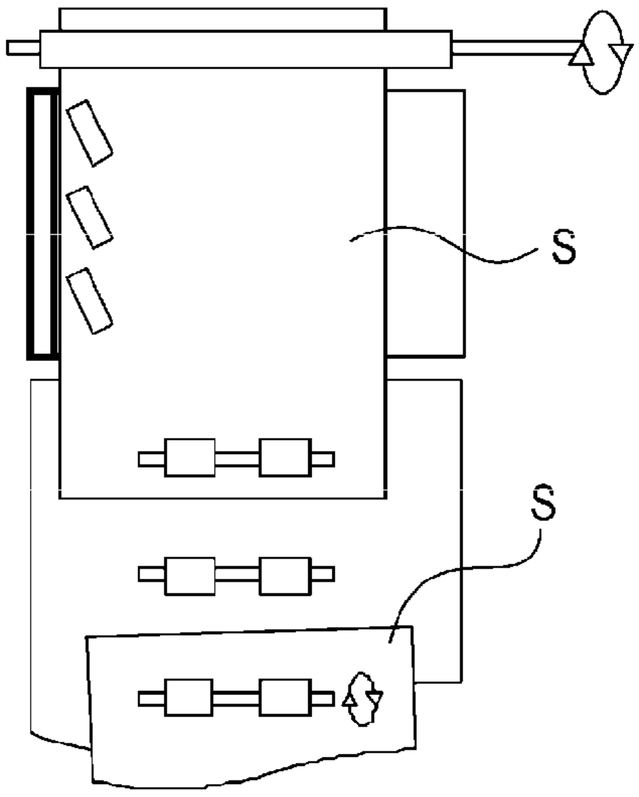


FIG. 2D

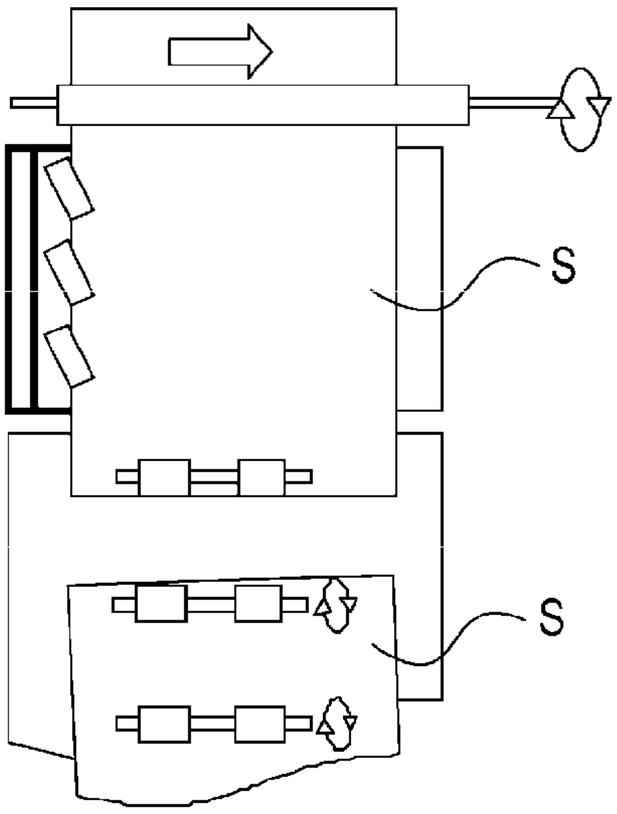


FIG. 3A

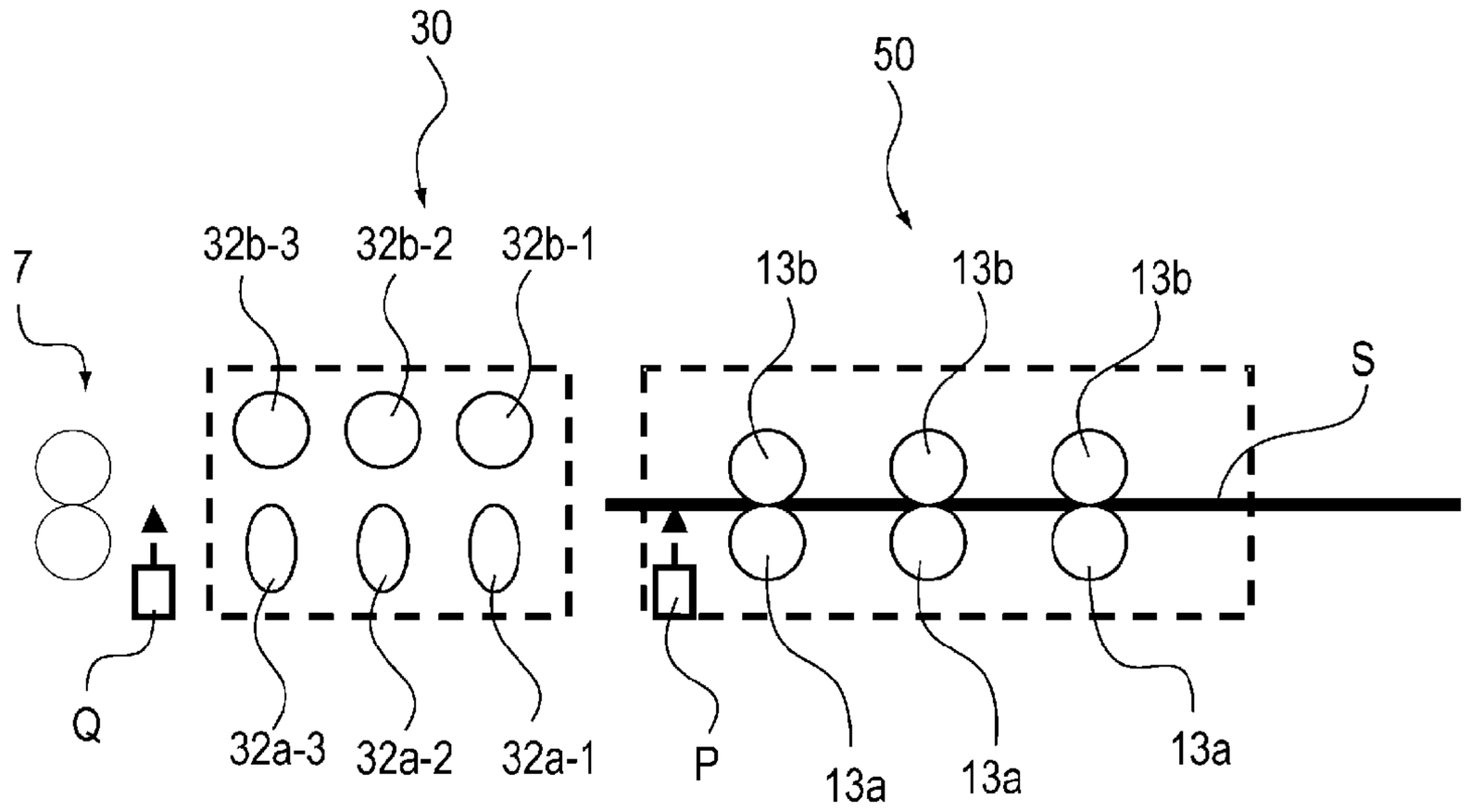

30
50
7
32b-3
32b-2
32b-1
13b
13b
13b
S
Q
32a-3
32a-2
32a-1
P
13a
13a
13a

FIG. 3B

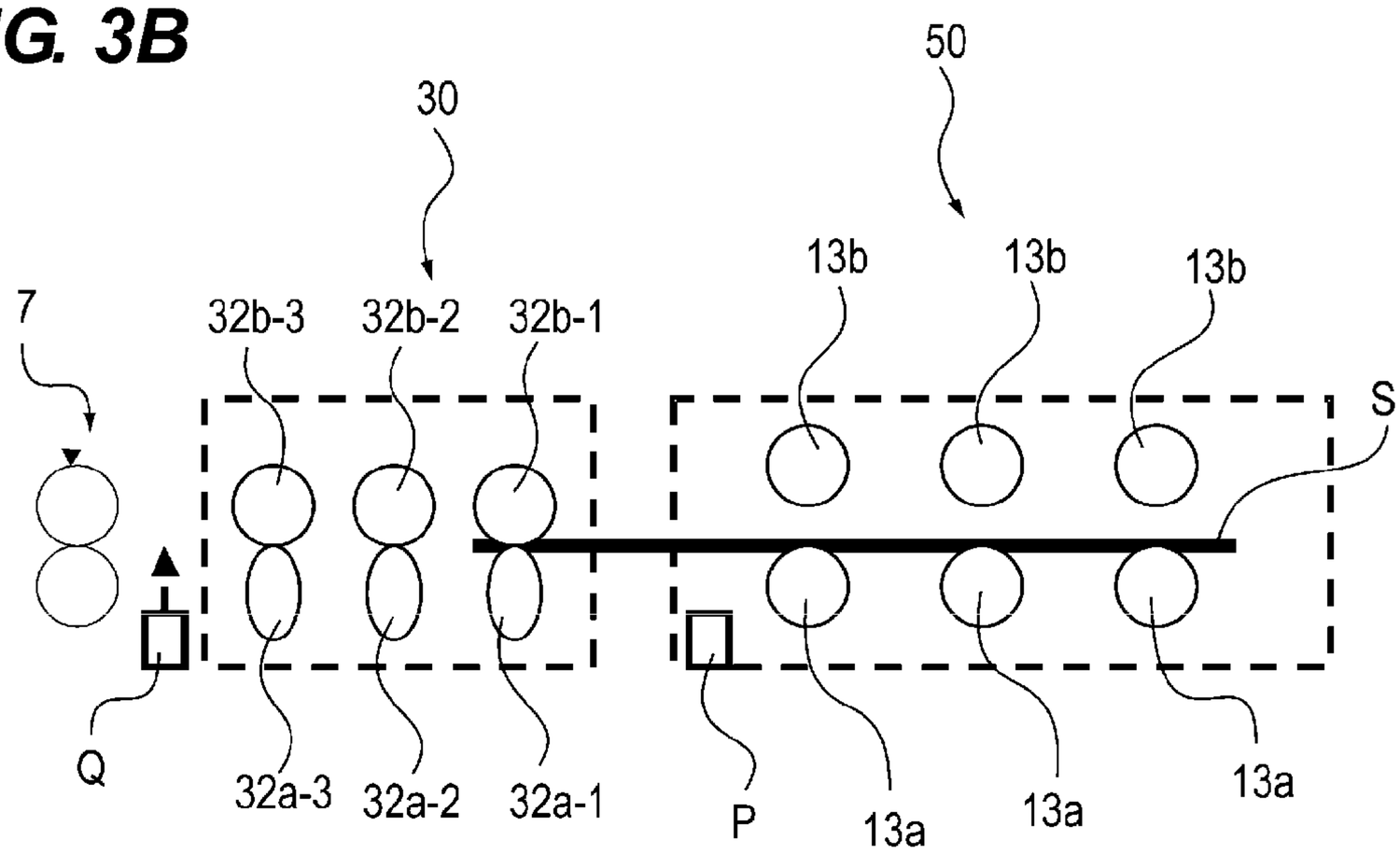

30
50
7
32b-3
32b-2
32b-1
13b
13b
13b
S
Q
32a-3
32a-2
32a-1
P
13a
13a
13a

FIG. 4A

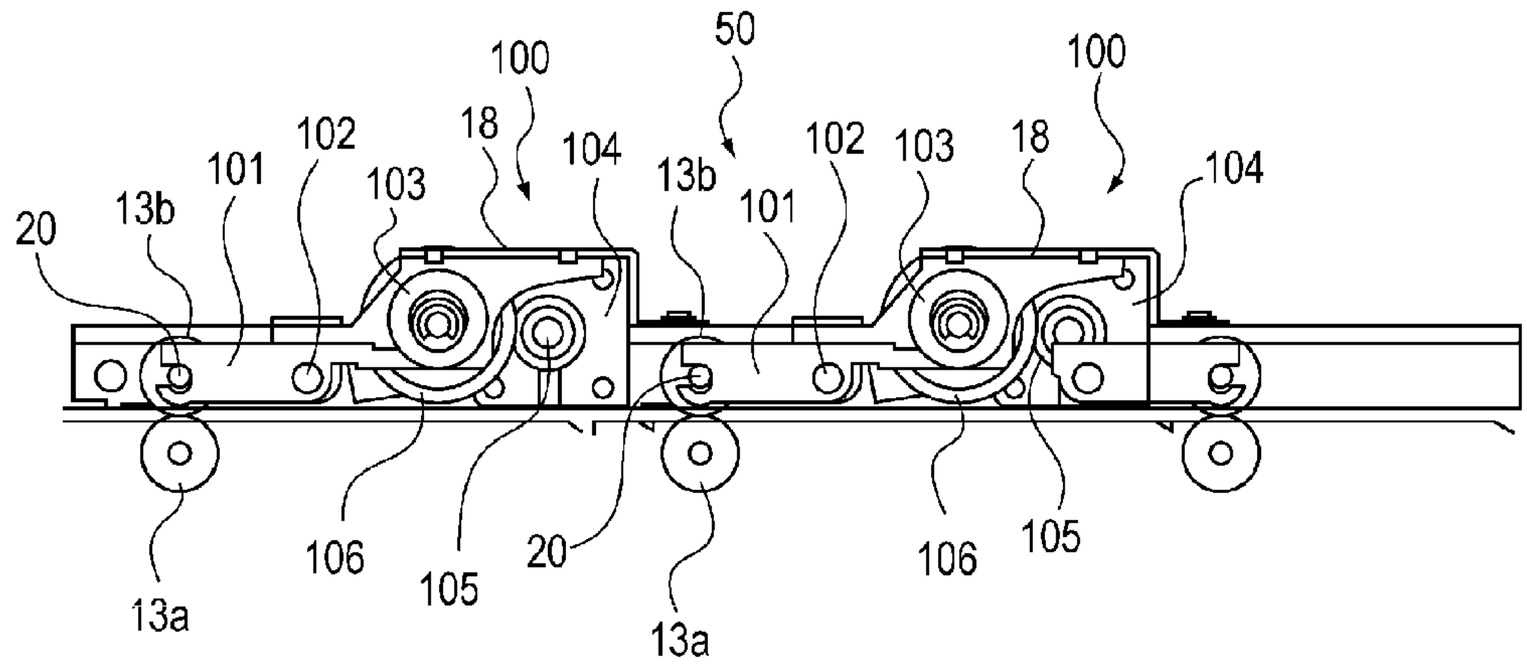

100
50
100
18
102
104
13b
102
103
18
104
20
13b
101
103
101
106
105
20
106
105
13a
13a

FIG. 4B

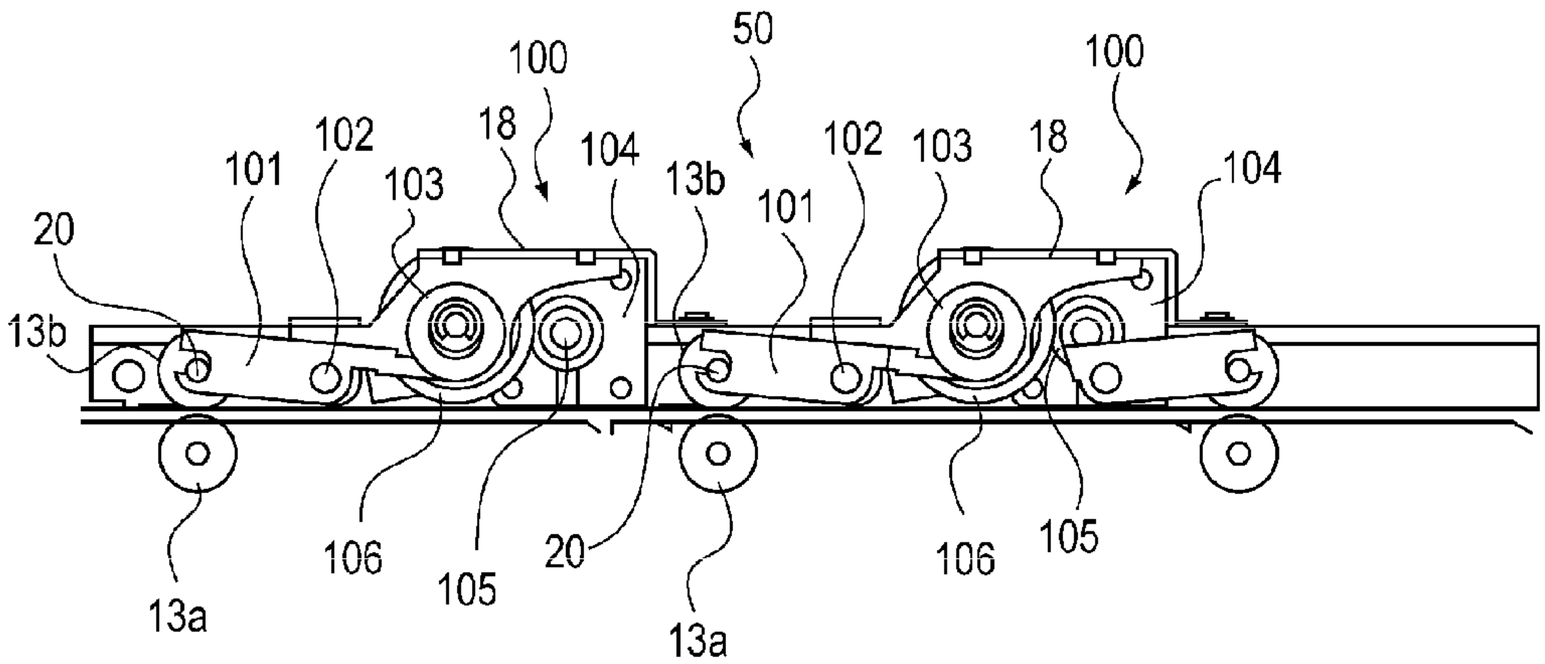

100
50
100
18
102
104
13b
102
103
18
104
101
103
20
13b
101
106
105
20
106
105
13a
13a

FIG. 5

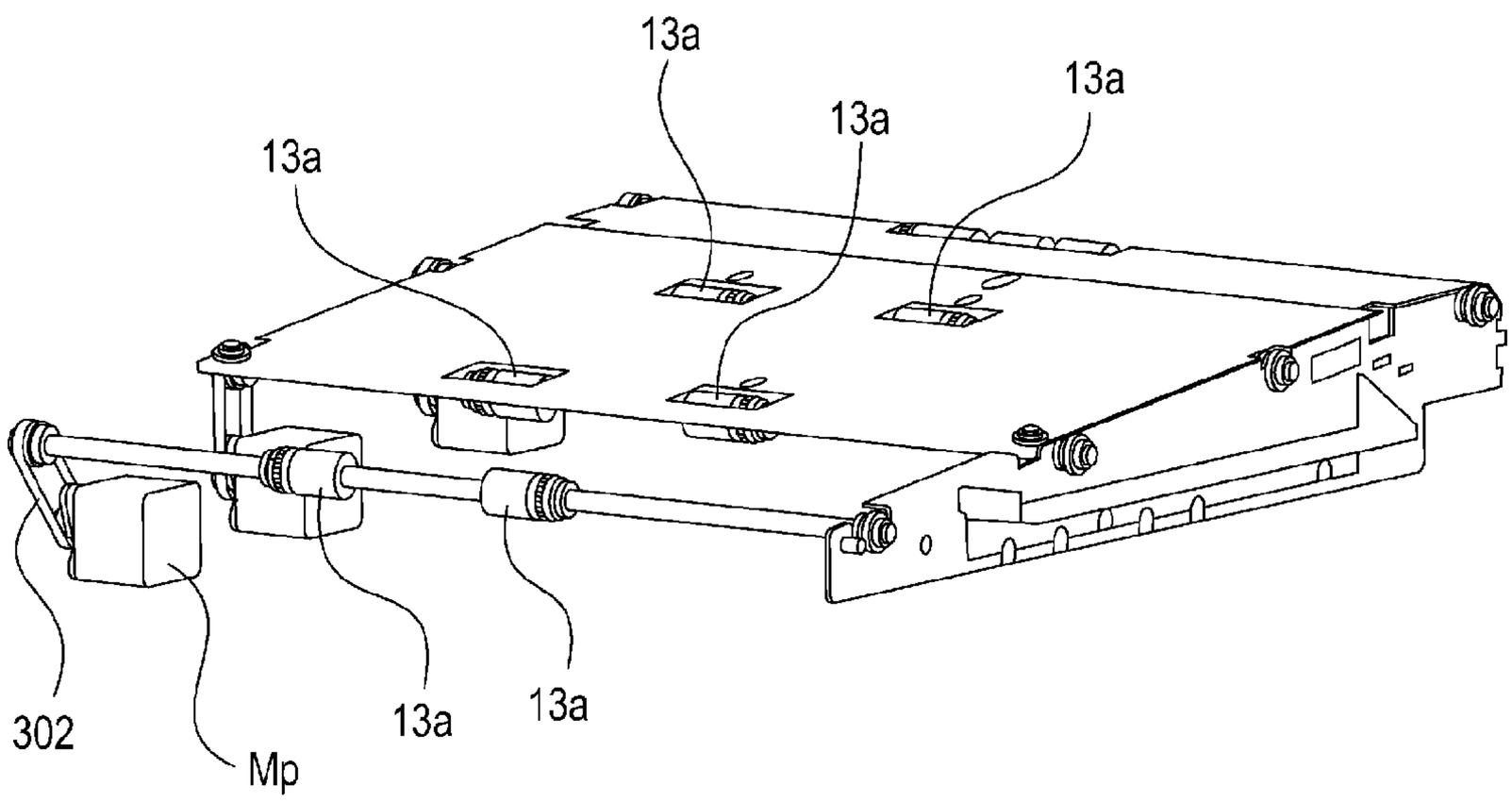


FIG. 6A

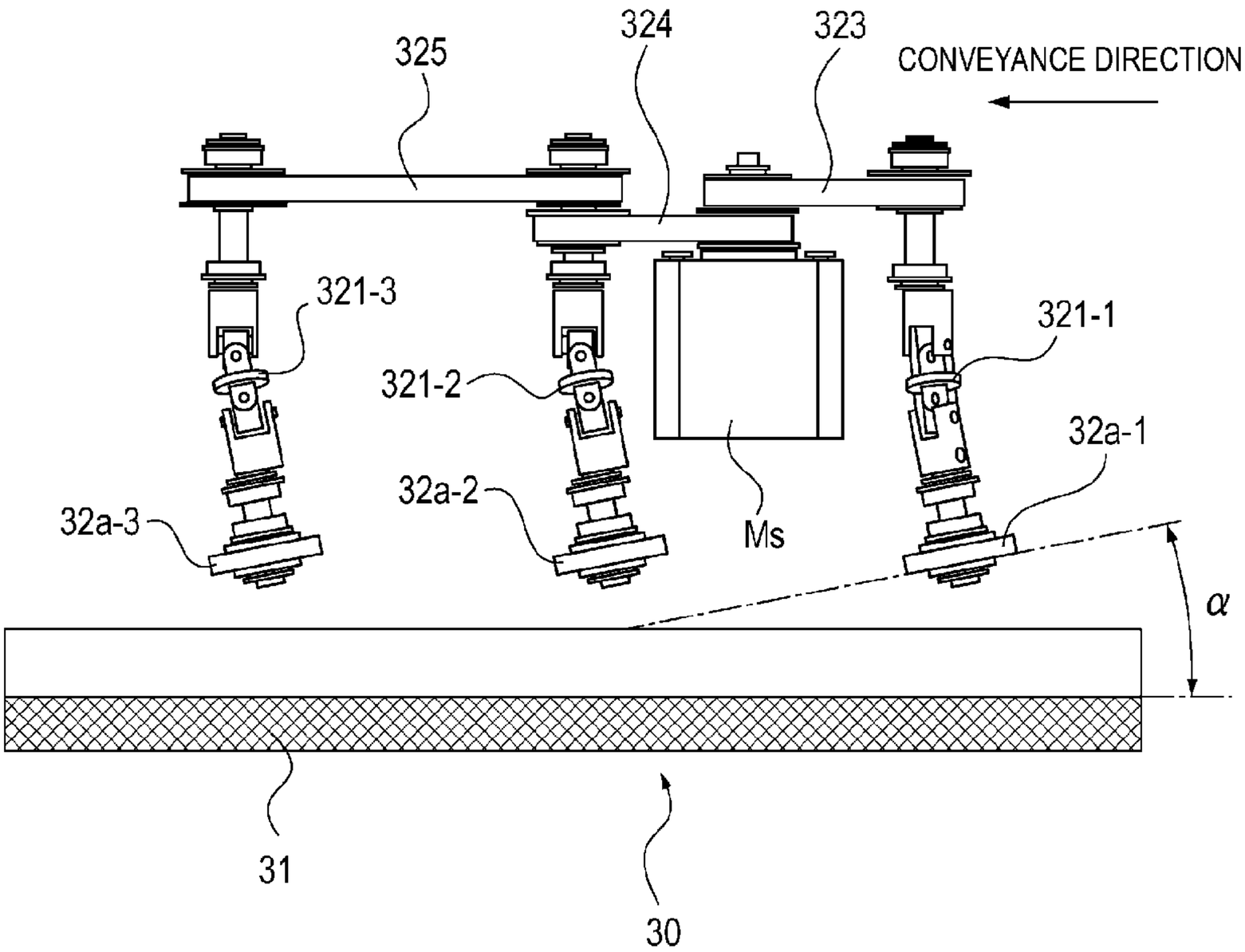

325
324
323
CONVEYANCE DIRECTION
321-3
321-2
321-1
32a-3
32a-2
32a-1
Ms
α
31
30

FIG. 6B

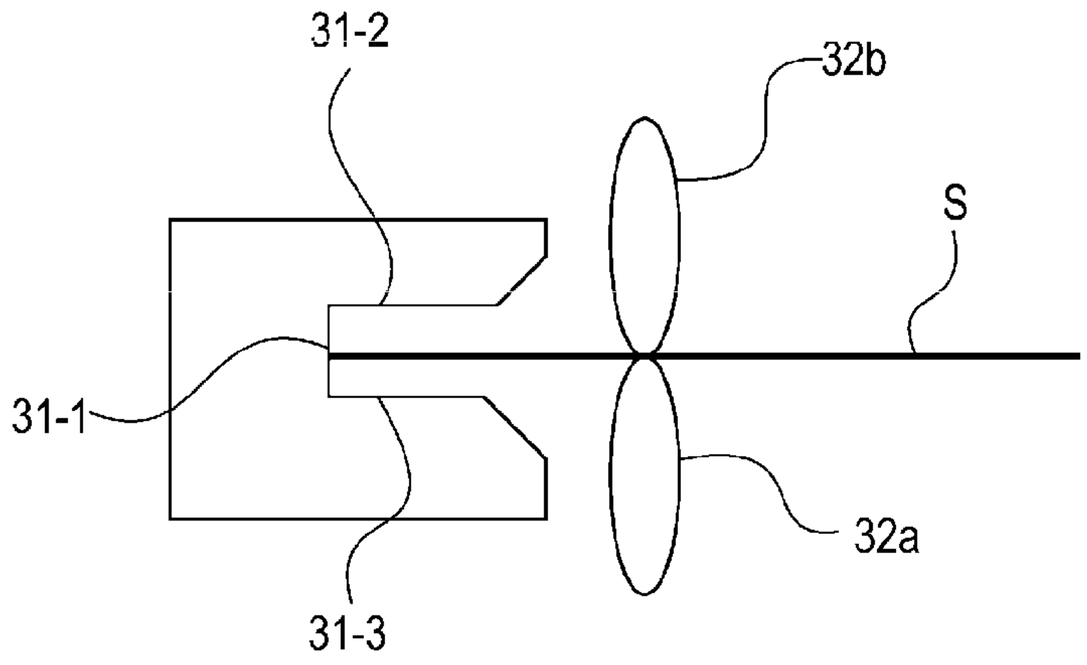

31-2
32b
S
31-1
32a
31-3

FIG. 7A

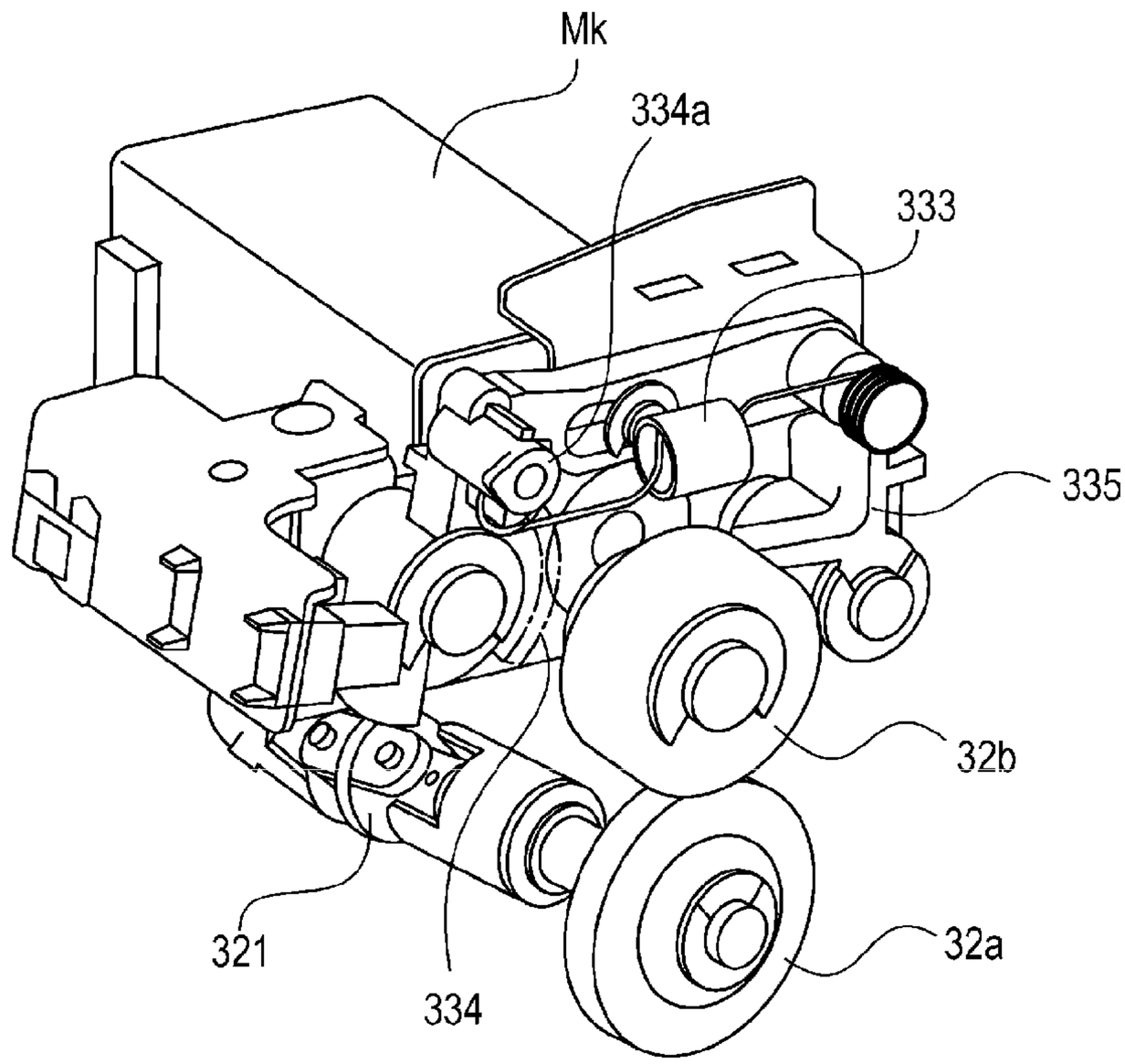

Mk
334a
333
335
32b
32a
321
334

FIG. 7B

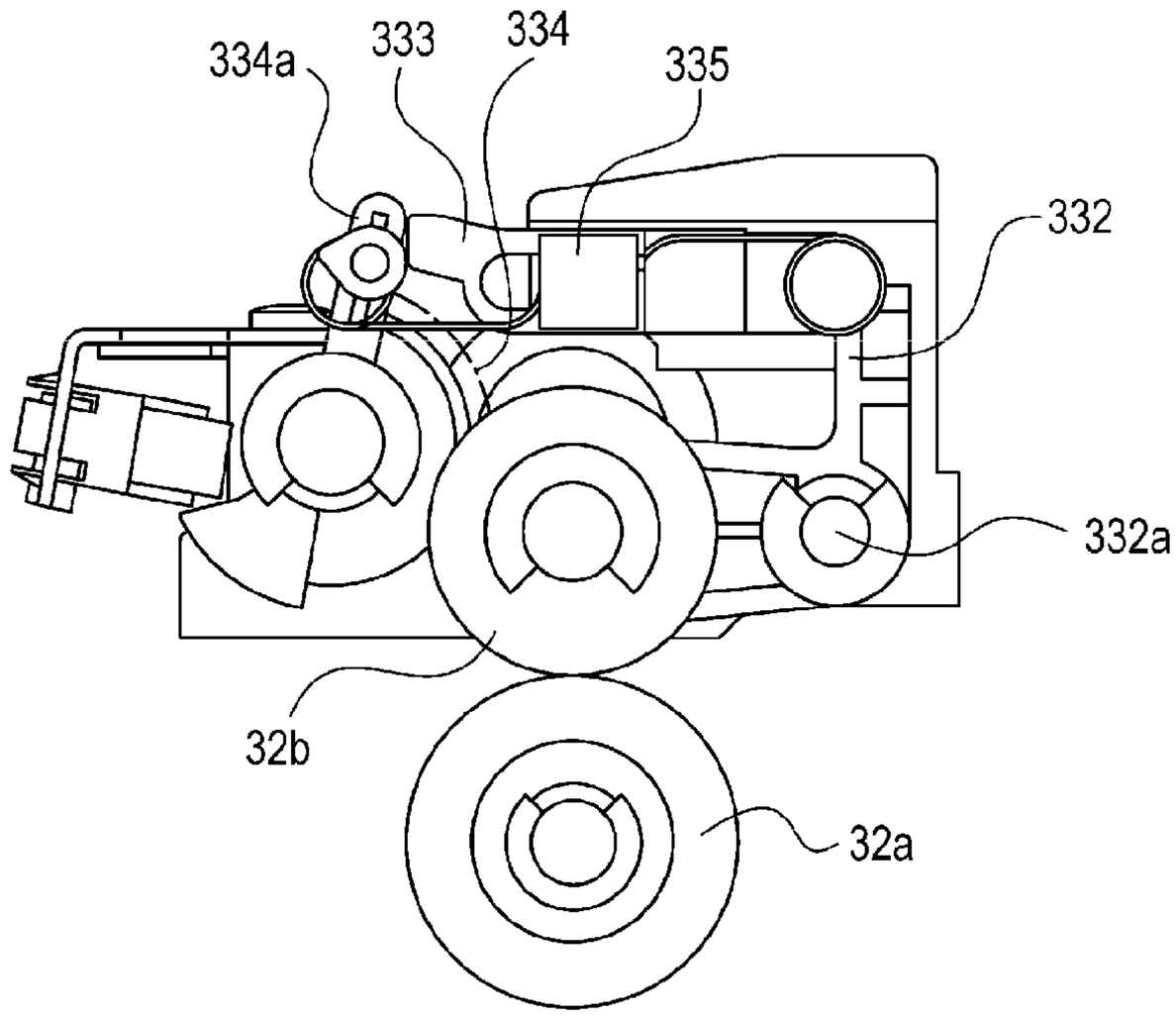

334a
333
334
335
332
332a
32b
32a

FIG. 8A

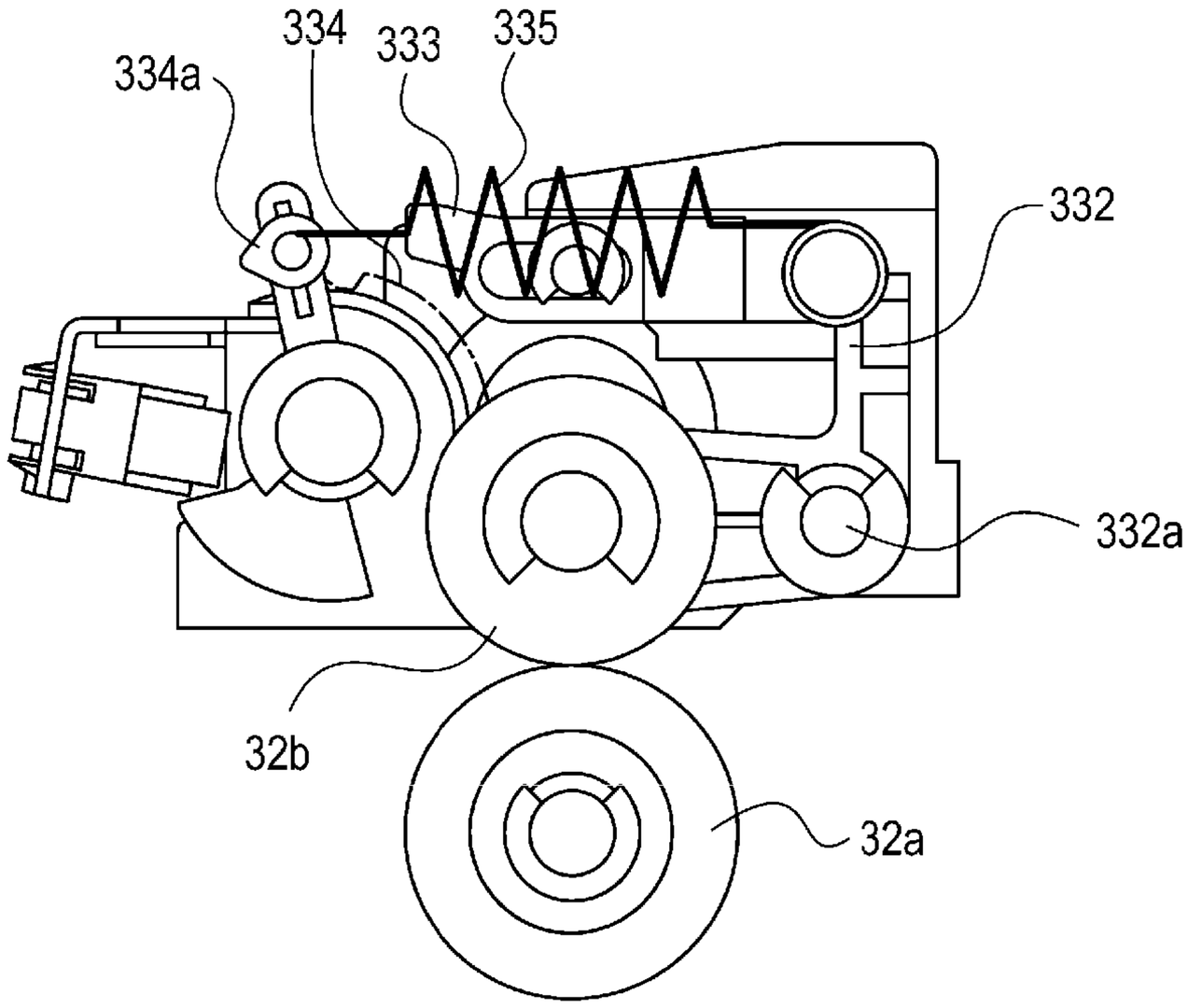

334
333
335
334a
332
332a
32b
32a

FIG. 8B

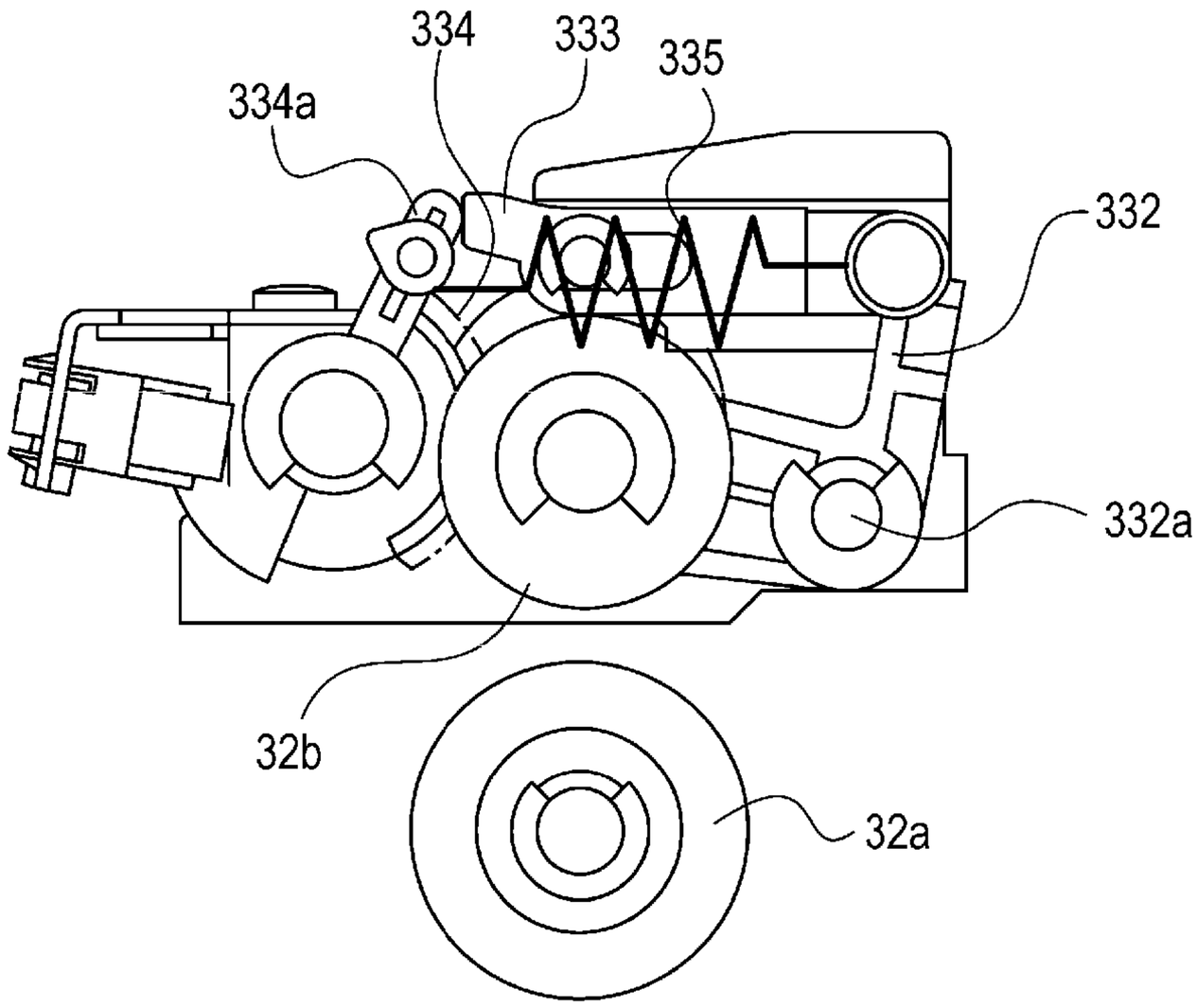

334
333
335
334a
332
332a
32b
32a

FIG. 9

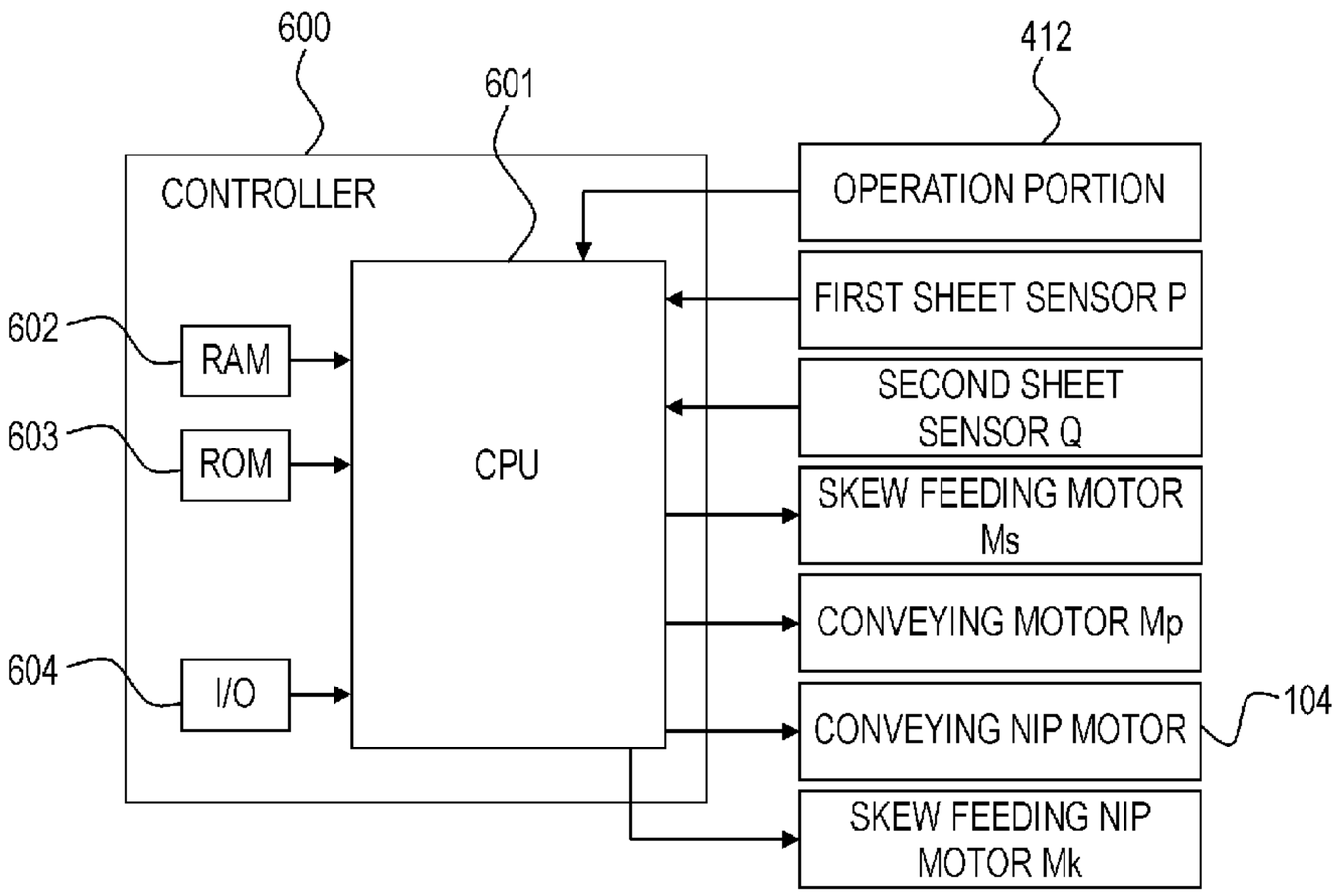

600
601
412
CONTROLLER
OPERATION PORTION
FIRST SHEET SENSOR P
SECOND SHEET SENSOR Q
SKEW FEEDING MOTOR Ms
CONVEYING MOTOR Mp
CONVEYING NIP MOTOR
104
SKEW FEEDING NIP MOTOR Mk
602
RAM
603
ROM
604
I/O
CPU

FIG. 10A

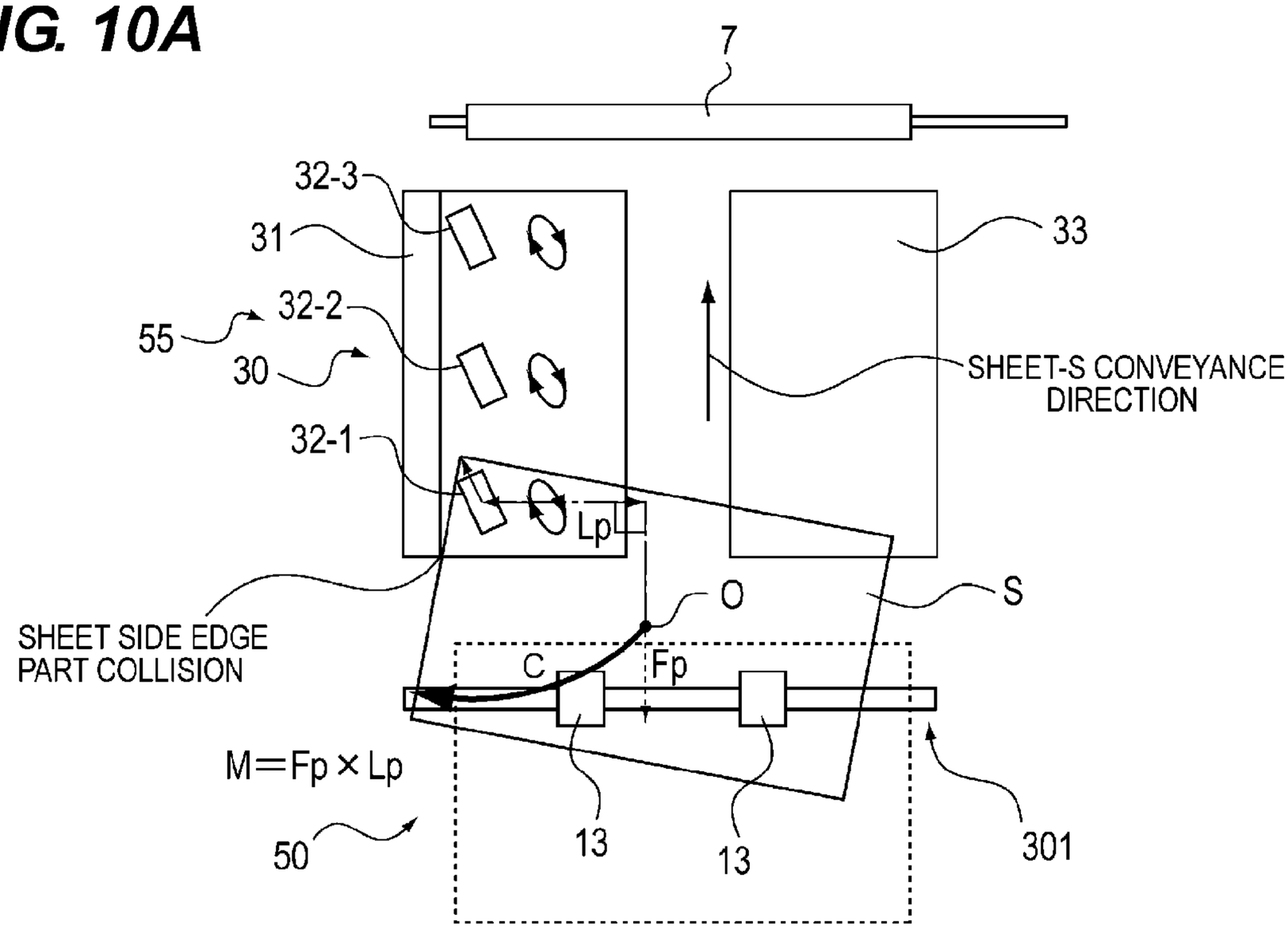


FIG. 10B

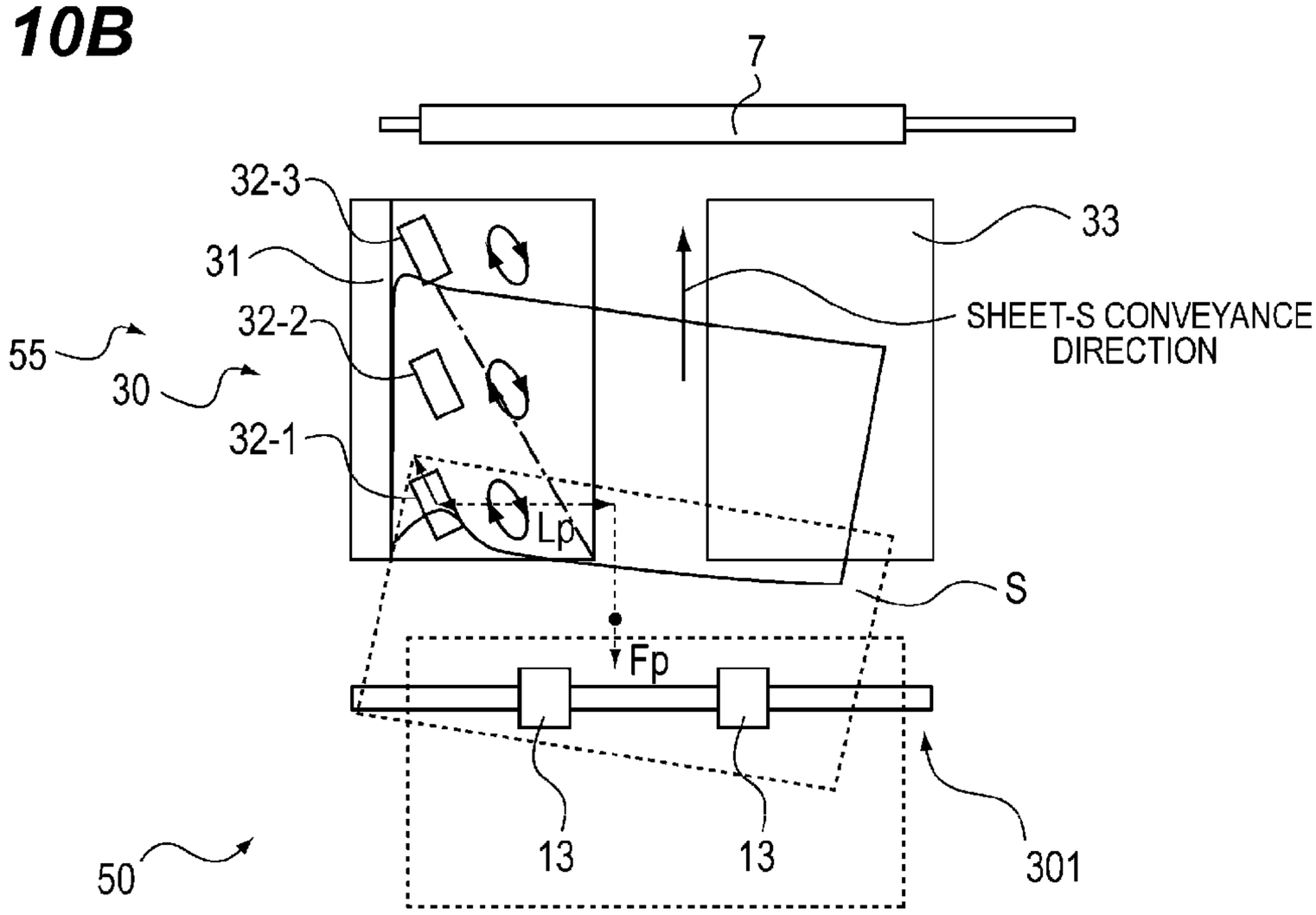


FIG. 11

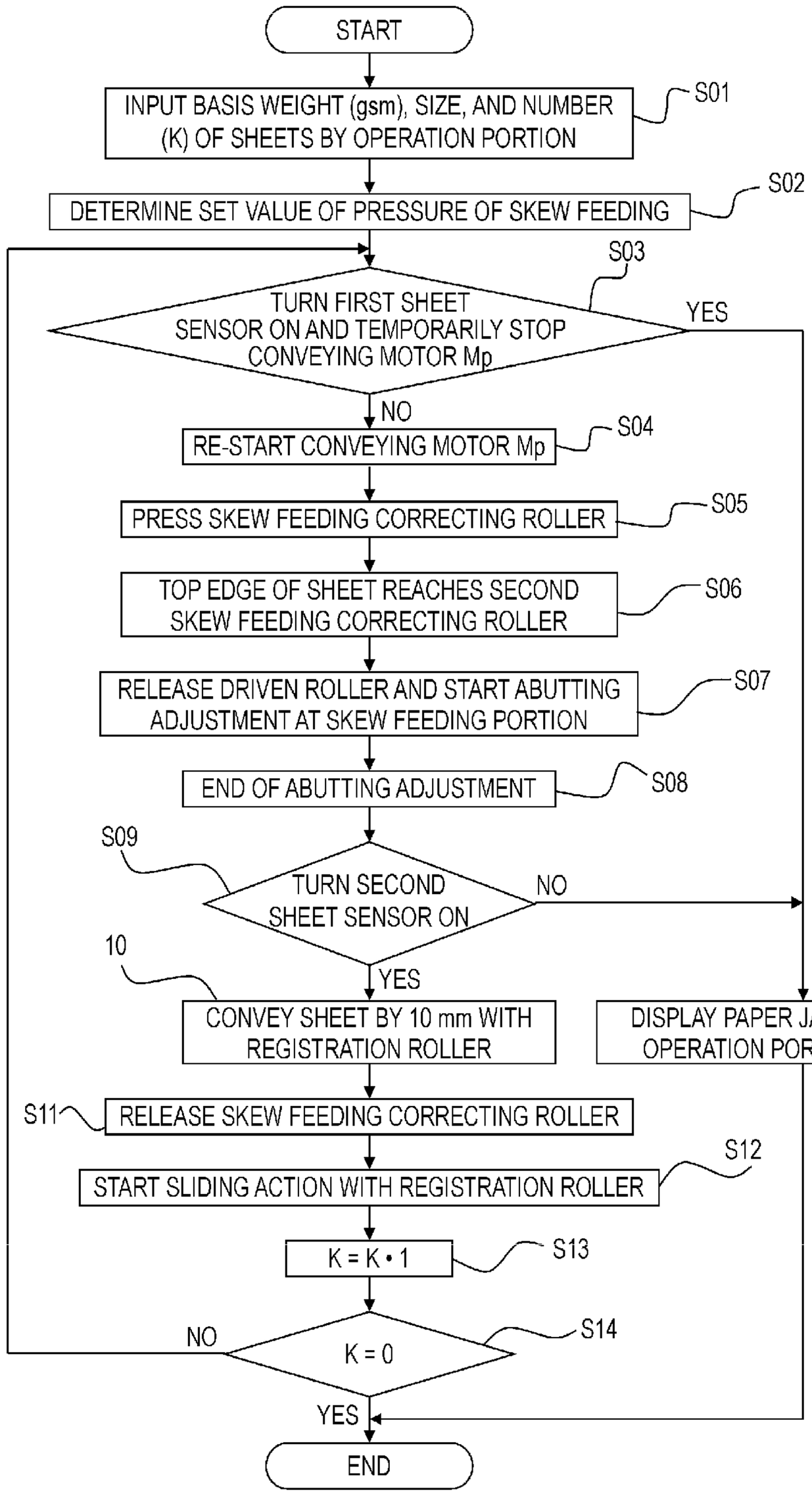

START
INPUT BASIS WEIGHT (gsm), SIZE, AND NUMBER (K) OF SHEETS BY OPERATION PORTION
S01
DETERMINE SET VALUE OF PRESSURE OF SKEW FEEDING
S02
S03
TURN FIRST SHEET SENSOR ON AND TEMPORARILY STOP CONVEYING MOTOR Mp
YES
NO
RE-START CONVEYING MOTOR Mp
S04
PRESS SKEW FEEDING CORRECTING ROLLER
S05
TOP EDGE OF SHEET REACHES SECOND SKEW FEEDING CORRECTING ROLLER
S06
RELEASE DRIVEN ROLLER AND START ABUTTING ADJUSTMENT AT SKEW FEEDING PORTION
S07
END OF ABUTTING ADJUSTMENT
S08
S09
TURN SECOND SHEET SENSOR ON
NO
YES
10
CONVEY SHEET BY 10 mm WITH REGISTRATION ROLLER
S15
DISPLAY PAPER JAM ON OPERATION PORTION
S11
RELEASE SKEW FEEDING CORRECTING ROLLER
S12
START SLIDING ACTION WITH REGISTRATION ROLLER
K = K • 1
S13
NO
K = 0
S14
YES
END

FIG. 12A

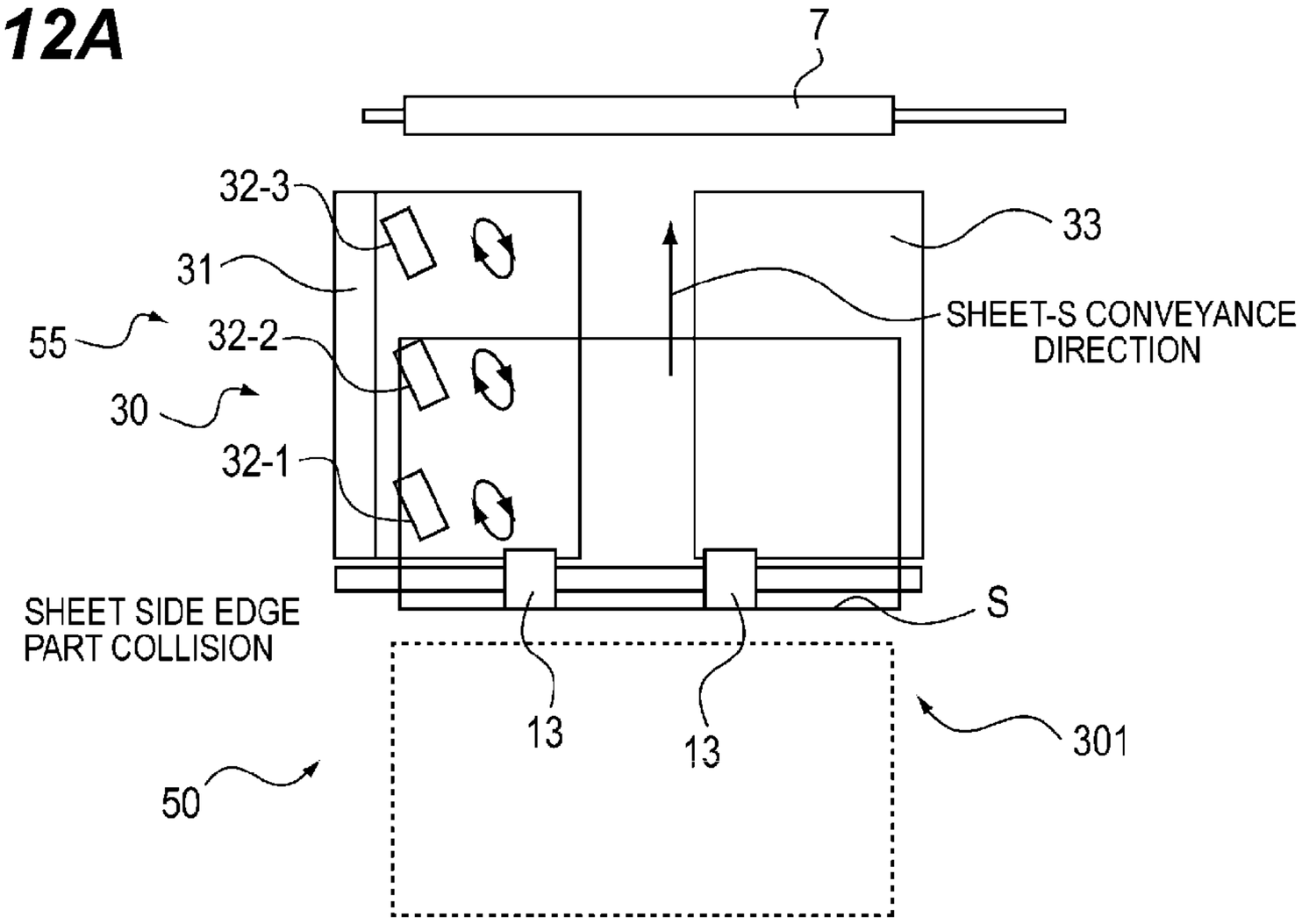


FIG. 12B

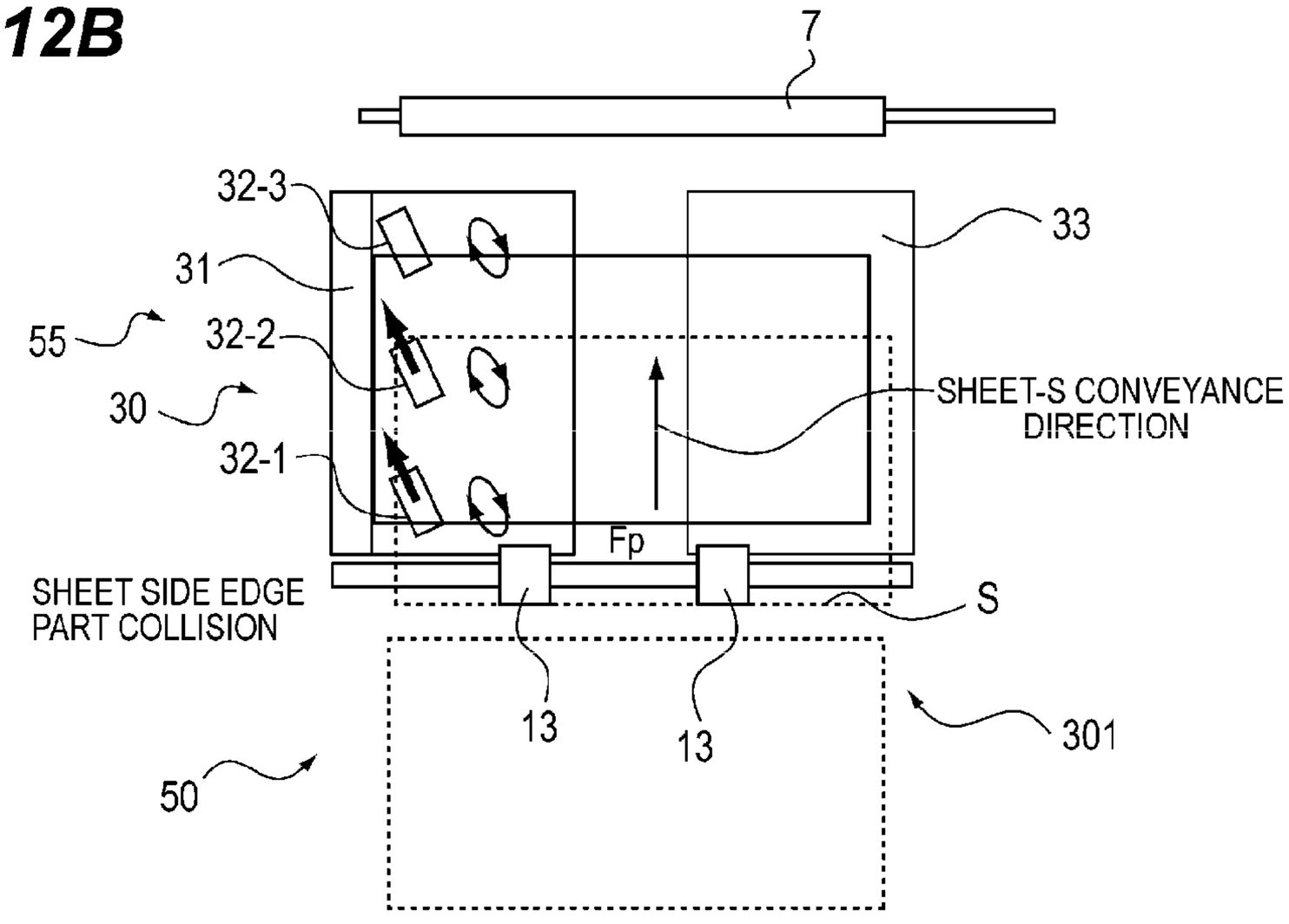
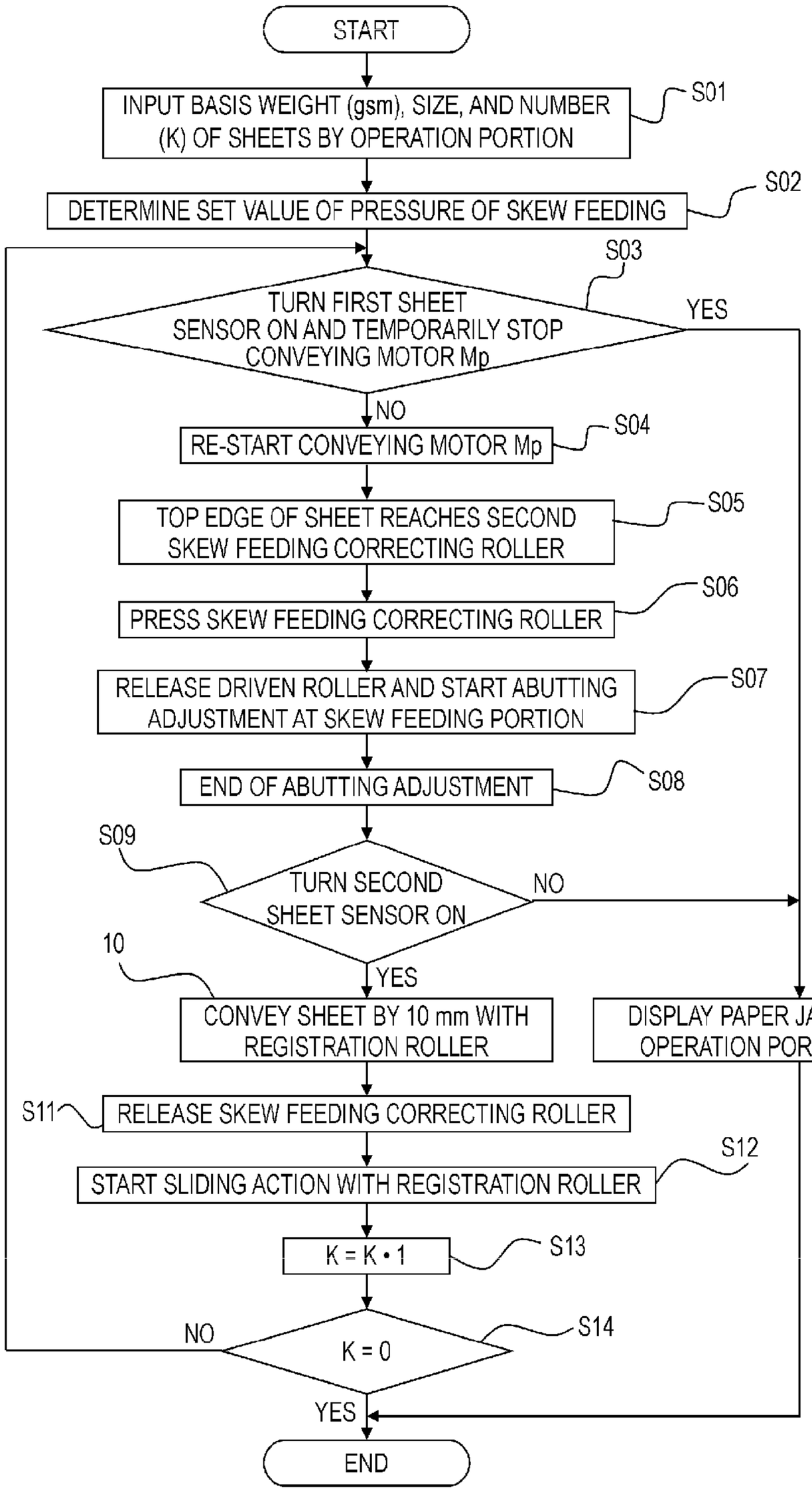


FIG. 13


START
INPUT BASIS WEIGHT (gsm), SIZE, AND NUMBER (K) OF SHEETS BY OPERATION PORTION
S01
DETERMINE SET VALUE OF PRESSURE OF SKEW FEEDING
S02
S03
TURN FIRST SHEET SENSOR ON AND TEMPORARILY STOP CONVEYING MOTOR Mp
YES
NO
RE-START CONVEYING MOTOR Mp
S04
TOP EDGE OF SHEET REACHES SECOND SKEW FEEDING CORRECTING ROLLER
S05
PRESS SKEW FEEDING CORRECTING ROLLER
S06
RELEASE DRIVEN ROLLER AND START ABUTTING ADJUSTMENT AT SKEW FEEDING PORTION
S07
END OF ABUTTING ADJUSTMENT
S08
S09
TURN SECOND SHEET SENSOR ON
NO
S15
10
YES
CONVEY SHEET BY 10 mm WITH REGISTRATION ROLLER
DISPLAY PAPER JAM ON OPERATION PORTION
S11
RELEASE SKEW FEEDING CORRECTING ROLLER
S12
START SLIDING ACTION WITH REGISTRATION ROLLER
K = K • 1
S13
NO
K = 0
S14
YES
END

SHEET CONVEYING APPARATUS AND IMAGE FORMING APPARATUS

BACKGROUND OF THE INVENTION

Field of the Invention

The present invention relates to a sheet conveying apparatus installed in an image forming apparatus such as a copying machine, a fax machine, and a printer in order to allow a sheet to be stably conveyed, and to an image forming apparatus provided with the sheet conveying apparatus.

Description of the Related Art

If a sheet in an image forming apparatus is skew-fed while being conveyed, or is misaligned in a width direction of the sheet perpendicular to the sheet conveyance direction, the apparatus ends up by forming an image misaligned with respect to the sheet. In order to deal with the problem, a sheet aligning apparatus is provided immediately in front of a transfer portion so as to correct skew feeding of a sheet and adjust the position of a sheet in its width direction. As an example of the sheet aligning apparatus, there is a sheet registration device for correcting a misalignment of a sheet being conveyed, with respect to a side edge of the sheet (see U.S. Pat. No. 6,273,418).

A sheet aligning apparatus that corrects skew feeding according to the side registration reference includes an abutting reference member along a direction in which a sheet is conveyed (sheet conveyance direction), and a pair of skew feeding correcting rollers above the sheet conveying path.

The abutting reference member has a reference surface parallel to the sheet conveyance direction. The number of pairs of skew feeding correcting rollers provided is at least two, and they are arranged along the reference surface in the sheet conveyance direction. While a sheet is being conveyed, the pairs of skew feeding correcting rollers skew-feed the sheet toward the abutting reference member and makes a side edge of the sheet abut against the reference surface so that the side edge will extend along the reference surface. The skew of the sheet in the sheet conveyance direction is thus corrected. Further, since the reference surface can fix the position of a side edge of a sheet with respect to a direction perpendicular to the sheet conveyance direction, the misalignment of a sheet in the width direction can be corrected based on the reference surface.

If the force of pressing the reference surface by a sheet (the force of drawing a sheet by the pairs of skew feeding correcting rollers) is excessively large when a side of the sheet is set to abut against the reference member in the sheet aligning apparatus, the sheet bends and a sheet jam or deterioration of correction accuracy occurs.

In order to solve the above problem, there is proposed an apparatus with existing pairs of skew feeding correcting rollers that adjusts the force of pressing the reference surface by a sheet by changing the nip pressure of a pair of skew feeding correcting rollers according to the thickness of a sheet, in correcting skew feeding with the existing pairs of rollers (see U.S. Pat. No. 5,253,862). This apparatus can correct skew feeding without bending a sheet when drawing a side edge of the sheet to the reference surface.

The existing method of correcting skew feeding of a sheet according to the side registration reference by adjusting the nip pressure of the skew feeding is disadvantageous in that there is difficulty in setting the position of a sheet in a stable state in correcting skew feeding, although the force of pressing the abutting reference member can be adjusted. In particular, when a sheet to be conveyed is such a paper as a coated paper with a basis weight of smaller than 80 gsm, which is super thin and has a small rigidity or when a sheet has a reduced rigidity under high-temperature and high-humidity environments, the following problems may occur.

The number of pairs of skew feeding correcting rollers provided is two or more, and they are arranged in the sheet conveyance direction. When an upstream pair of the skew feeding correcting rollers that first conveys a sheet starts conveying a sheet, the sheet is rotated and is caused to abut against the reference surface of the abutting reference member at a side edge of the sheet with a bent occurring at the side edge. Although a sheet with a large rigidity is not easily bent, a sheet with a small rigidity is bent and passed to a next pair of skew feeding correcting rollers. Accordingly, the difference in the degree of bending generated in the sheet conveyance direction can result into insufficient correction of skew feeding, or the bending can lead to buckling (breaking) and a paper jam may be caused.

SUMMARY OF THE INVENTION

The present invention has been made in view of the above problems, and provides a sheet conveying apparatus and an image forming apparatus which have a skew feeding correcting mechanism capable of reliably correcting skew feeding of a sheet even with a small rigidity.

A sheet conveying apparatus according to the present invention includes: a first rotary portion which nips and conveys a sheet; a reference surface which is provided along a direction in which the sheet is conveyed; a plurality of second rotary portions arranged along the sheet conveyance direction, each of the portions nipping and obliquely conveying the sheet conveyed by the first rotary portion so as to contact the side edge of the sheet to the reference surface; a first switching portion which switches the first rotary portion between a state of nipping the sheet and a state of nip releasing the sheet; a second switching portion which switches and the second rotary portions between a state of nipping the sheet and a state of nip releasing the sheet; and a controller which controls the first switching unit and the second switching unit so that the nip of the sheet by the first rotary portion is released after the conveyed sheet is nipped by at least two of the second rotary portions.

Further features of the present invention will become apparent from the following description of exemplary embodiments with reference to the attached drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a diagram illustrating an image forming apparatus provided with a sheet conveying apparatus.

FIGS. **2**A to **2**D are schematic top views of the sheet conveying apparatus.

FIGS. **3**A and **3**B are schematic cross-sectional views of the sheet conveying apparatus.

FIGS. **4**A and **4**B are cross-sectional views of a conveying portion with a nip pressure applied and removed, respectively.

FIG. **5** is a perspective view of a driving portion of the conveying portion.

FIGS. **6**A and **6**B are a drive top view of a skew feeding portion and an explanation diagram of a reference member, respectively.

FIGS. **7**A and **7**B are perspective and side views of a pressing mechanism of the skew feeding portion, respectively.

FIGS. **8**A and **8**B are side views of the skew feeding portion with a nip pressure applied and removed, respectively.

FIG. **9** is a control block diagram.

FIGS. **10**A and **10**B are sheet behavior diagrams at the time of aligning a sheet.

FIG. **11** is a flow chart illustrating the procedures for correcting skew feeding according to a first embodiment.

FIGS. **12**A and **12**B are sheet behavior diagrams at the time of aligning a sheet according to the first embodiment.

FIG. **13** is a flow chart illustrating the procedures for correcting skew feeding according to a second embodiment.

DESCRIPTION OF THE EMBODIMENTS

[First Embodiment]

A sheet conveying apparatus and an image forming apparatus provided with the sheet conveying apparatus according to an embodiment of the present invention will be hereinafter described in detail with reference to accompanying drawings.

<Image Forming Apparatus>

First, descriptions will be made of the entire configuration of an image forming apparatus according to the embodiment. Color image forming apparatuses are roughly grouped into a rotary system and a tandem system according to configurations, the rotary system having a configuration in which a plurality of image forming portions is arranged in a row and a tandem system having a configuration in which a plurality of image forming portions is arranged in a cylindrical pattern. Further, they are also grouped into a direct transfer system and an intermediate transfer system according to transfer system, the direct transfer system being a system of directly transferring a toner image onto a sheet material from a photoreceptor and the intermediate transfer system being a system of transferring a toner image on a sheet material after transferring the toner image on an intermediate transfer member.

FIG. **1** illustrates an image forming apparatus according to an embodiment of the present invention that uses the intermediate transfer tandem system, in which image forming portions of four colors are arranged in a row on an intermediate transfer belt. The intermediate transfer system is applicable to different kinds of transfer materials including a super-thick paper and a coated paper, because the intermediate transfer system does not require a transfer material to be held on a transfer drum or a transfer belt, unlike the direct transfer system. Moreover, the intermediate transfer system is suitable for realizing high productivity since it can perform parallel processing by a plurality of image forming portions and transfer of full-colored images all at once. The configuration and operation of an image processor according to the embodiment will be described.

A sheet S is contained to be placed on a lift-up apparatus **52** of a sheet feeding apparatus **51**, and is fed by a sheet feeding portion **53** when an image is formed by the image forming apparatus. The sheet feeding portion **53** may employ one of methods using the friction and division by a feeding roller, for example, and using division and adsorption by air, and it adopts a feeding method using air in the image forming apparatus of the embodiment.

The sheet S fed by the sheet feeding portion **53** passes through a conveyance path **54***a* of a conveying unit **54** and reaches a skew feeding correcting portion **55**. Further, the skew feeding correcting portion **55** conducts skew feeding correction and timing correction, the sheet is sent to a secondary transfer portion. The secondary transfer portion is a nip part having a secondary transfer inner roller **503** and a secondary transfer outer roller **56** practically facing each other, and transfers a toner image onto the sheet S. Specifically, the secondary transfer portion transfers an unfixed image onto the sheet S by applying a predetermined pressure and electrostatic load bias.

Subsequently, descriptions will be made of a process of forming an image, the image being sent to the secondary transfer portion concurrently with the conveyance of the sheet S to the secondary transfer portion.

An image forming apparatus **513** mainly includes a photoreceptor **508**, an exposure apparatus **511**, a developing apparatus **510**, a primary transfer unit **507**, and a photoreceptor cleaner **509**. The photoreceptor **508** is uniformly charged, in advance, on a surface thereof by a charging portion, and rotates in a direction indicated by an arrow A in FIG. **1**. The exposure apparatus **511** emits a light to the photoreceptor **508** based on a signal of received image information, and the light adequately passes through a diffraction member **512**, for example, so that an electrostatic latent image is formed. The developing apparatus **510** develops the latent image formed on the photoreceptor **508** with toner, and a toner image is formed on the photoreceptor. Thereafter, the primary transfer unit **507** applies a predetermined pressure and transfer bias and the toner image is transferred onto the intermediate transfer belt **506**. Subsequently, a small amount of toner which is left on the photoreceptor **508** is collected by the photoreceptor cleaner **509** and will be used for the next image formation. The embodiment uses four image forming apparatuses **513** for yellow (Y), magenta (M), cyan (C), and black (Bk) colors. The colors are not limited to the four colors above and the order of colors is not limited to the above.

The intermediate transfer belt **506** is stretched by such rollers as the driving roller **504**, a tension roller **505**, and the secondary transfer inner roller **503**, and is driven to convey a sheet into a direction indicated by an arrow B in FIG. **1**. Accordingly, the image formation processes for obtaining images of the colors Y, M, C, and Bk carried out in parallel by the image forming apparatuses **513** are conducted concurrently with overlapping with an upstream toner image primarily transferred on the intermediate transfer belt. Thus, a full-colored toner image is formed on the intermediate transfer belt **506** and is conveyed to the secondary transfer portion.

In that way, a full-colored toner mage is secondary-transferred onto the sheet S in the secondary transfer portion through the sheet-S conveyance process and the image formation process. The sheet S is thereafter conveyed to a fixing apparatus **58** by a pre-fixing conveying portion **57**. The fixing apparatus **58** makes the toner fused and fixed on the sheet S with a predetermined pressure by rollers, belts, etc. practically facing each other and with an effect of heating by a heat source such as a heater. The sheet S with the image fixed thereon is discharged to a discharge tray **500** by a branch conveying apparatus **59**, or is conveyed to a reverse conveying apparatus **501** if the sheet S needs an image fixed on both surfaces.

When an image is to be formed on both surfaces of the sheet S, the sheet S conveyed to the reverse conveying apparatus **501** is switched back so that the front and back edges of the sheet S are switched, and is conveyed to a double surface conveying apparatus **502**. Next, the sheet S joins a sheet for a subsequent job conveyed from the sheet feeding apparatus **51** at a re-feeding path **54***b* of the con-

veying unit **54**, and is sent to the secondary transfer portion. The image formation process for the front surface is applied to the back surface.

In the sheet conveyance paths of the conveying unit **54**, the branch conveying apparatus **59**, the reverse conveying apparatus **501**, and the double surface conveying apparatus **502**, there are a large number of conveying roller apparatuses. Each conveying roller apparatus conveys a sheet while nipping the sheet between a driving roller and a driven roller. Further, in each conveying roller apparatus, a driven roller is provided with a biasing member such as a spring so that a pressure of nipping a sheet between the rollers is set.

<Sheet Conveying Apparatus>

Subsequently, descriptions will be made of the sheet conveying apparatus used in the image forming apparatus. FIGS. **2**A to **2**D illustrate top views of a sheet aligning apparatus having a conveying portion **50**, a skew feeding correcting portion **55**, and a registration roller **7**.

The sheet conveying apparatus according to the embodiment has the skew feeding correcting portion **55** for correcting a misalignment of a sheet while the sheet is being conveyed. Among the methods employable by the skew feeding correcting portion **55** is one according to a side registration reference, which corrects a misalignment of a sheet with respect to a side edge of the sheet when the sheet is being conveyed. The present embodiment is a case where the skew feeding correcting portion **55** is arranged at the upper position of the secondary transfer portion. Other than at the upper position of the secondary transfer portion, the skew feeding correcting portion **55** applying the side registration reference may be used in a sheet post-processing apparatus for performing post processing on a fixed sheet.

The sheet conveying apparatus includes the conveying portion **50** which nips and conveys a sheet with a pair of conveying rollers **13**, and the skew feeding correcting portion **55** having a pair of skew feeding correcting rollers **32** for drawing the sheet conveyed by the conveying portion **50** to a reference member to align the sheet.

The conveying portion **50** includes a plurality of pairs of conveying rollers **13**, which are first rotary portions and are arranged in the sheet conveyance direction. Each pair of conveying rollers **13** is formed of a driving roller **13***a* and a driven roller **13***b*, the driving roller **13***a* being driven and rotated by driving force of a motor (drive source) and the driven roller **13***b* being pressed with and rotated by the driving roller **13***a*. The number of pairs of conveying rollers **13** provided is at least two, and they are arranged in the sheet conveyance direction. Further, the driven roller **13***b* is formed to freely press against or become separated from the driving roller **13***a*. With that configuration, nip and nip release of a sheet by the pair of conveying rollers **13** can be switched.

The skew feeding correcting portion **55** mainly includes a skew feeding portion **30** which draws a sheet to the reference member and a fixed guide **33**. The skew feeding portion **30** can move into a width direction of the sheet S perpendicular to the sheet S according to the size of the sheet S. The skew feeding portion **30** includes an abutting reference member **31** which determines the position of a side edge of a sheet to be conveyed along the conveyance direction, and a plurality of pairs of skew feeding correcting rollers **32** (**32-1**, **32-2**, and **32-3**) as the second rotary portions.

Although the embodiment employs three pairs of skew feeding correcting rollers **32-1**, **32-2**, and **32-3** arranged from the upper to the lower side of the sheet conveyance direction, the number of the pairs of skew feeding correcting rollers **32** may be four or more.

Each pair of skew feeding correcting rollers **32** is formed of a driving roller **32***a* and a driven roller **32***b*, the driving roller **32***a* being driven and rotated by a motor and the driven roller **32***b* being pressed with and rotated by the driving roller **32***a*. The number of pairs of skew feeding correcting rollers provided is at least two, and they are arranged in the sheet conveyance direction. The driven roller **32***b* is formed to freely press against or become separated from the driving roller **32***a*. With that configuration, the nip and nip release of the sheet by the pairs of skew feeding correcting rollers can be switched.

It is to be noted that in the embodiment, the skew feeding correcting portion **55** has a registration roller **7** for conveying a sheet to the secondary rotary portion.

As FIGS. **2**A, **6**A, and **6**B illustrate, the abutting reference member **31** has a reference surface **31-1** parallel to the direction in which the sheet S is conveyed. The direction in which the pairs of skew feeding correcting rollers **32** convey a sheet is inclined at a predetermined angle α to the reference surface **31-1** of the abutting reference member **31**. Accordingly, a side edge of the sheet S conveyed by the pairs of skew feeding correcting rollers **32** is caused to abut against the reference surface **31-1**.

Assume that the sheet S enters the skew feeding correcting portion **55** while being skew-fed with a side edge being at an angle β to the reference surface **31-1**, as illustrated in FIG. **2**A. The sheet S conveyed to the pairs of skew feeding correcting rollers **32** by the pair of conveying rollers **13** is obliquely conveyed to the abutting reference member **31**, as illustrated in FIG. **2**B. A side edge of the sheet S is made to abut against the reference surface **31-1** of the abutting reference member **31** by the skew feeding correcting portion **55**, and is aligned to become parallel to the sheet conveyance direction, as illustrated in FIG. **2**C. Subsequently, when the sheet S is nipped by the registration roller **7**, the pairs of skew feeding correcting rollers **32** release the nip of the sheet S, as illustrated in FIG. **2**D. Thereafter, the registration roller **7** slides into the width direction of the sheet perpendicular to the sheet conveyance direction while nipping the top edge of the sheet S**1**, in order to match the position of an image to the position of the sheet.

(Configuration of Nip and Nip Release by the Conveying Portion)

Next, the configuration of a first switching unit will be described, which switches the pair of conveying rollers **13** between a state of nipping a sheet and a state of nip releasing a sheet.

FIGS. **3**A and **3**B are cross-sectional views illustrating the nip releasing actions of the pair of conveying rollers **13** and the pairs of skew feeding correcting rollers **32**. The pair of conveying rollers **13** is formed of a driving roller **13***a* of rubber and a driven roller **13***b* of resin. Between the conveying portion **50** and the skew feeding portion **30** (upper side of the conveyance direction of the skew feeding portion **30**), a first sheet sensor P as the first detecting portion is provided. Further, a second sheet sensor Q as the second detecting portion is provided immediately in front of the registration roller **7**. The first sheet sensor P is for detecting the passage of the top edge of a sheet through the conveying portion **50**, and the second sheet sensor Q is for detecting the conveyance of the top edge of a sheet to immediately in front of the registration roller **7**. The first and second sheet sensors P and Q are each an optical sensor having a light emitting portion and a light receiving portion. When the sheet S passes, the light receiving portion detects reflected light from the sheet S and outputs a detection signal. Based on detection signals from the first and second sheet sensors P

and Q, a controller **600** detects the timing of passage of the sheet S. The controller **600** will be described later.

When the first sheet sensor P detects the top edge of a sheet, the controller **600** stops a conveying motor Mp which drives the driving roller **13***a* of the pair of conveying rollers **13**, based on a detection signal from the first sheet sensor P. The stop of driving of the pair of conveying rollers **13** can adjust variations in the sheet conveyance time. The sheet S is thereafter conveyed to the skew feeding portion **30**, the driven roller **13***b* is released, and the skew feeding correction is started.

The nip releasing mechanism of the pair of conveying rollers **13** is configured as FIGS. **4**A and **4**B illustrate. FIG. **4**A is a cross-sectional diagram illustrating a state of the pair of conveying rollers **13** when a nip pressure is applied. The driven roller **13***b* is supported by an arm member **101** also supporting a driven shaft **20**, and the arm member **101** is arranged to a stray member **18** via a rocking shaft **102** so as to freely rock. The nip is released in such a manner that an eccentric roller **103** is rotated to press an edge part of the arm member **101** and the nip is rotated in the release direction around the rocking shaft **102**.

FIG. **4**B is a cross-sectional diagram illustrating a state of the pair of conveying rollers **13** when the nip is released. The conveying portion **50** has a pressing unit for pressing the arm member **101**. Specifically, the arm member **101** is rocked with the rocking shaft **102** as the center, in such a manner that the conveying nip motor **104** as a stepping motor is rotated and the eccentric roller **103** is rotated by a gear row **105** and **106**. In that way, the nip by the driven roller **13***b* is released in response to the timing of release. The controller **600** drives the conveying nip motor **104** according to the time of detection by the first sheet sensor P so that the time of releasing the nip can be varied.

FIG. **5** is a perspective view of a driving portion of the conveying portion **50**. The driving roller **13***a* receives drive force from the conveying motor Mp via a pulley and a belt **302** at a shaft integrally formed with a rubber roller, the conveying motor Mp being a stepping motor. The timings of starting and stopping the rotation and the number of rotations (rate of conveyance) are controlled by the controller **600** based on detection signals from the first sheet sensor P.

(Configuration of Nip and Nip Release by the Skew Feeding Portion)

Next, the configuration of a second switching unit will be described, which switches the pairs of skew feeding correcting rollers **32** between a state of nipping a sheet and a state of nip releasing a sheet. FIG. **6**A is a top view of a driving portion of the skew feeding portion **30**. The pairs of skew feeding correcting rollers **32** are arranged to be at the angle α to the abutting reference member **31**, as described above. Each driving roller **32***a* (**32***a*-**1**, **32***a*-**2**, and **32***a*-**3**) receives drive force from the skew feeding motor Ms via a universal joint **321** (**321**-**1**, **321**-**2**, and **321**-**3**), a pulley, and conveyance belts **323**, **324**, and **325**. The skew feeding motor Ms for driving the pairs of skew feeding correcting rollers **32** is a stepping motor. The timings of starting and stopping the rotation and the number of rotations (rate of conveyance) are controlled by the controller **600**.

FIG. **6**B is a cross-sectional view of the abutting reference member **31** viewed from the sheet conveyance direction in FIG. **6**A. The abutting reference member **31** has a reference surface **31**-**1** against which a side edge of the sheet S abuts, and an upper guide **31**-**2** and a lower guide **31**-**3** defining the upper and lower directions of the sheet S, respectively.

FIGS. **7**A and **7**B are perspective and side views of a pressing/separation mechanism of the driving roller **32***a* and the driven roller **32***b* facing each other of a pair of skew feeding correcting roller, respectively.

As FIGS. **7**A and **7**B illustrates, the driven roller **32***b* has a tension spring **335** between an L-shaped link **332** rotatably supporting the driven roller **32***b* and an arm portion **334***a* provided to the pressure gear **334**, and the skew feeding nip motor Mk allows the pressure gear **334** to rotate. The nip pressure (nip pressure of the sheet S) is set according to the rotation angle of the skew feeding nip motor Mk.

FIG. **8**A illustrates a state of a pair of skew feeding correcting rollers **32** when a nip pressure is applied. The pressure gear **334** stops after having rotated in the counter-clockwise direction in FIG. **8**A and the tension spring **335** is pulled so that the link **332** is rotated around the shaft **332***a*, whereby the nip of the pair of skew feeding correcting rollers **32** is pressed.

FIG. **8**B illustrates a state of a pair of skew feeding correcting rollers **32** when a nip pressure is removed. The pressure gear **334** stops after having rotated in the clockwise direction in FIG. **8**B, and the arm portion **334***a* pressurizes the link **333**, whereby the link **332** supporting the driven roller **32***b* is rotated around the shaft **332***a* in the clockwise direction. This action causes the driven roller **32***b* to be separated from the driving roller **32***a*, resulting into release of the nip. Since the skew feeding nip motor Mk is a stepping motor, setting a step angle makes it possible to vary the setting of a nip pressing amount for the pairs of skew feeding correcting rollers **32**.

The driven rollers **32***b* of a plurality of pairs of skew feeding correcting rollers **32** (3 pairs in the embodiment, a first pair of rollers **32***a*-**1**, **32***b*-**1**, a second pair of rollers **32***a*-**2**, **32***b*-**2** and a third pair or rollers **32***a*-**3**, **32***b*-**3**) individually have the pressing/separation mechanism for the pairs. Accordingly, the nip pressures of the driven rollers **32***b* (**32***b*-**1**, **32***b*-**2**, and **32***b*-**3**) can be independently set. Further, the driven rollers **32***b* can be separated from their corresponding driving rollers **32***a*.

<Control Block Diagram>

FIG. **9** is a block diagram illustrating the components controlling the nip pressing and nip releasing for the pairs of skew feeding correcting rollers **32** of the skew feeding correcting portion **55**.

The controller **600** includes a CPU **601**, program storage ROM **603**, data temporary-storage RAM **602**, and a communication I/O **604**. A user confirms the paper size, the basis weight (gsm), and the number of sheet passing, by inputting, at the operation portion **412**, information on the sheet S to be used.

The controller **600** controls the skew feeding nip motor Mk based on detection signals from the first sheet sensor P and the second sheet sensor Q, whereby the nip pressing and nip releasing for each pair of skew feeding correcting roller **32** are controlled.

Further, the controller **600** controls the conveying motor Mp, the conveying nip motor **104**, the drive of the driving roller **13***a* of the conveying portion **50**, and the nip pressing/releasing for the driven roller **13***b*.

Likewise, the controller **600** controls the skew feeding motor Ms, the skew feeding nip motor Mk, the drive of the driving roller **32***a* of the skew feeding correcting portion **55**, and the nip pressing/releasing for the driven roller **32***b*. Since the driven rollers **32***b* of the skew feeding correcting portion **55** individually have the skew feeding nip motor Mk, it is possible to separately control the nip pressing forces (skew feeding pressures), nip pressing timings, and nip releasing timings for the driven rollers **32***b*-**1**, **32***b*-**2**, and **32***b*-**3**.

<Timing of Nip of the Sheet>

Next, descriptions will be made of the timing of nip of the sheet by the pairs of skew feeding correcting rollers **32** of the skew feeding correcting portion **55** according to the embodiment. A method for correcting skew feeding of a sheet according to the embodiment will be described after a method using the side registration reference according to a comparative example is described with reference to FIGS. **10**A and **10**B.

FIGS. **10**A and **10**B illustrate the skew feeding correcting method for describing the comparative example. In the comparative example, as illustrated in FIG. **10**A, the nip of the sheet by the pair of conveying rollers **13** of the conveying portion **50** is released when the top edge of the sheet S conveyed by the conveying portion **50** is nipped by the uppermost pair of skew feeding correcting rollers **32-1** of a plurality of pairs of skew feeding correcting rollers **32**.

When the nip of the sheet by the pair of conveying rollers **13** is released, the sheet S receives force Fp into a direction opposite to the conveyance direction due to frictional force generated by friction between the sheet S and a fixed guide **33**, for example. If the center of gravity of the sheet S is denoted by O and the distance between the center of gravity and the pair of skew feeding correcting rollers **32-1** in the width direction of the sheet is denoted by Lp, the sheet S receives a moment M expressed by Fp×Lp. With the moment M applied, the sheet S starts rotating in the direction indicated by an arrow C around the pair of skew feeding correcting rollers **32-1**, and collides against an entry part of the abutting reference member **31** at a side edge of the sheet S, which causes bending of the sheet S at the side edge.

If the sheet S is small in thickness and rigidity, it is conveyed to the lower direction with the side edge bent, and skew feeding is caused in some cases, as FIG. **10**B illustrates. In particular, if the sheet S is a sheet extremely small in rigidity such as a coated paper with a basis weight of smaller than 80 gsm, the bending can lead to buckling (breaking) and eventually to a paper jam.

In order to deal with the problem, the embodiment is so configured that the nip of a sheet by the pair of conveying rollers **13** is released after the top edge of the conveyed sheet reaches at least two of the pairs of skew feeding correcting rollers **32**, as the flow chart of FIG. **11** illustrates.

More specifically, the basis weight (gsm), size, and number (K) of sheet passing are input at the operation portion (Step S**01**) and sheet passing is started. A set value of the nip pressure force (skew feeding pressure) for the pairs of skew feeding correcting rollers **32** is determined based on the basis weight or size of the sheets (Step S**02**).

When the sheet having been fed reaches the conveying portion **50**, it is conveyed to the skew feeding portion **30** while being nipped by the pair of conveying rollers **13**. Further, when the first sheet sensor P detects the top edge of the sheet S (ON), the controller **600** stops temporarily the conveying motor Mp based on the detection signal and adjusts the inter-paper time (Step S**03**). When the first sheet sensor P, on the other hand, does not detect the top edge of the sheet S for a predetermined time, the controller **600** makes the operation portion display a paper jam (delay jam) and the processing ends (S**15**).

Subsequently, the conveying motor Mp is restarted (Step S**04**), and the sheet S is conveyed to the skew feeding portion **30**. The skew feeding nip motor Mk is driven at a time chosen from the restart of the conveying motor Mp to before the arrival of the top edge of the sheet S to the pairs of the skew feeding correcting rollers **32** so that the respective driven rollers **32***b*-**1**, **32***b*-**2**, and **32***b*-**3** of the pairs of skew feeding correcting rollers **32-1**, **32-2**, and **32-3** are pressed. In that way, the nip pressure of the pairs of skew feeding correcting rollers **32** is set at the set value of the skew feeding pressure previously determined (Step S**05**). It is to be noted that the driven rollers may be simultaneously pressed or sequentially pressed from the upper to the lower side of the conveyance direction.

Thereafter, the pair of conveying rollers **13** releases the nip of the sheet by releasing the nip (nip release). Since the timing of the nip release is an important feature of the embodiment, it will be described in detail based on the behavior of the sheet with reference to FIGS. **12**A and **12**B.

The nip release of the sheet by the pair of conveying rollers **13** is conducted after the top edge of the sheet reaches the one of the plurality of pairs of skew feeding correcting rollers **32** arranged which is second nearest pair of skew feeding correcting rollers **32** from the upstream side. Herein, the time required for the top edge of the sheet to reach the second nearest pair of skew feeding correcting rollers **32** from the upstream side is calculated by a CPU **601** based on the detection of the top edge by the first sheet sensor P and the rate of sheet conveyance by the pair of conveying rollers **13**. After the time obtained by the calculation has passed, the conveying nip motor **104** is driven to release the nip by the pair of conveying rollers **13**. The nip of the sheet S by the pair of conveying rollers **13** is thus released after the sheet S is nipped by two pairs of skew feeding correcting rollers **32**.

The sheet conveyance force of the conveying portion **50** is set to be larger than that of the pairs of skew feeding correcting rollers **32**. Hence, if the sheet is nipped by the uppermost pair of skew feeding correcting rollers **32-1**, the pair of skew feeding correcting rollers **32-1** is slipping during the nip of the sheet by the pair of conveying rollers **13** and the rotation as described above does not generate.

Further, when the sheet is nipped by the second pair of skew feeding correcting rollers **32-2** as illustrated in FIGS. **12**A and **12**B, the nip of the sheet by the pair of conveying rollers **13** is released, and skew feeding correction is started (Step S**07**). Since the sheet is nipped by two pairs of skew feeding correcting rollers **32-1** and **32-2**, occurrence of rotation can be prevented by cancelling a rate vector generating at the conveyance by one of the pairs of skew feeding correcting rollers with the other pair of skew feeding correcting rollers.

By releasing the nip of the sheet by the pair of conveying rollers **13** as described above, the sheet can be prevented from rotating and occurrence of skew feeding and paper jam can be avoided.

Thereafter, the sheet passes through the skew feeding correcting portion **55** and the skew feeding correction ends (Step S**08**). After that, if the second sheet sensor Q detects the top edge of the sheet S (Step S**09**), the controller **600** drives the registration roller **7** based on the detection signal. After the registration roller **7** has conveyed sheets in a predetermined amount (10 mm of sheets in the embodiment) (Step S**10**), the nips by all the pairs of skew feeding correcting rollers **32** are released (Step S**11**). Subsequently, the registration roller **7** starts sliding into the axial direction (Step S**12**).

As the timing of releasing the nip of the sheet by the pairs of skew feeding correcting rollers **32**, the release of the nip of the sheet by the pairs of skew feeding correcting rollers **32** is conducted based on the time of detection (ON) of the sheet by the second sheet sensor Q according to a soft-count value of a sum of a time obtained by dividing the distance between the second sheet sensor Q and the registration roller

7 by the sheet conveyance rate of the skew feeding portion **30** and a time necessary for conveying a predetermined amount of sheets (10 mm of sheets in the embodiment) by the registration roller **7**.

Further, when the second sheet sensor Q does not detect (ON) the top edge of the sheet S, the controller **600** makes the operation portion display a paper jam (delay jam), and the processing ends (Step S**15**).

After that, the sheet passing counter determines that K is K−1 (Step S**13**), and if K is not 0 (Step S**14**), the nip pressure of the pair of conveying rollers **13** is increased again (not illustrated in the drawing) when the pairs of skew feeding correcting rollers **32** have completed sheet alignment, so that continuous sheet passing is conducted. The processing ends when the sheet passing counter determines that K is 0 (Step S**14**).

[Second Embodiment]

Next, descriptions will be made of a method of correcting skew feeding that pays attention to the durability of the pairs of the skew feeding correcting rollers **32** as a second embodiment.

As described above, a sheet in the first embodiment is conveyed to the skew feeding portion **30** after the nip pressure of the pairs of skew feeding correcting rollers **32** is set. However, a sheet may be nipped by a pair of skew feeding correcting rollers **32** after the top edge of the sheet reaches the one of the plurality of pairs of skew feeding correcting rollers **32** which is second nearest pair of skew feeding correcting rollers **32** from the upstream side, as illustrated in the flow chart of FIG. **13**.

Note that in the flow chart of FIG. **13**, the sequence of Steps S**05** and S**06** in the flow chart of FIG. **11** according to the first embodiment is switched.

By setting the nip pressure of the sheet by a pair of skew feeding correcting rollers **32** to a predetermined value after the sheet reaches the second nearest pair of skew feeding correcting rollers **32** from the upstream side as in the second embodiment, the time for the pair of skew feeding correcting rollers **32** to slip is reduced and the durability of the driving rubber roller of the pair of skew feeding correcting rollers is improved compared to in the first embodiment.

While the present invention has been described with reference to exemplary embodiments, it is to be understood that the invention is not limited to the disclosed exemplary embodiments. The scope of the following claims is to be accorded the broadest interpretation so as to encompass all such modifications and equivalent structures and functions.

This application claims the benefit of Japanese Patent Application No. 2014-077456, filed Apr. 4, 2014, which is hereby incorporated by reference herein in its entirety.

What is claimed is:

1. A sheet conveying apparatus comprising:

a pair of rotary portions that nip and convey a sheet in a sheet conveying direction;

a reference surface which is provided along the sheet conveying direction;

a first conveying portion which, obliquely with respect to the sheet conveying direction, conveys the sheet conveyed by the pair of rotary portions so as to contact the side edge of the sheet to the reference surface;

a second conveying portion which is disposed downstream of the first conveying portion in the sheet conveying direction and which, obliquely with respect to the sheet conveying direction, conveys the sheet so as to contact the side edge of the sheet to the reference surface;

a switching portion which switches the pair of rotary portions between a state of nipping the sheet and a state of nip releasing the sheet;

a detecting portion which detects the sheet conveyed by the pair of rotary portions; and

a controller which controls to stop the rotation of the pair of rotary portions based on the detection of the detecting portion before the leading edge of the sheet reaches the second conveying portion, and controls the switching portion so that the nip of the sheet by the pair of rotary portions is released after the pair of rotary portions starts rotating and the leading edge of the sheet in the conveying direction reaches the second conveying portion.

2. The sheet conveying apparatus according to claim **1**, wherein

the detecting portion is disposed downstream of the pair of rotary portions and upstream of the first conveying portion in the sheet conveying direction.

3. The sheet conveying apparatus according to claim **1**, wherein the pair of rotary portions includes a pair of rollers formed of a driving roller and a driven roller, the driving roller being rotated by driving force from a drive source and a driven roller being pressed with the driving roller.

4. The sheet conveying apparatus according to claim **1**, wherein a sheet conveying force of the pair of rotary portions is set to be larger than that of the first conveying portion.

5. The sheet conveying apparatus according to claim **1**, wherein a direction of conveying the sheet by the first conveying portion and the second conveying portion is at a predetermined angle with respect to the reference surface.

6. The sheet conveying apparatus according to claim **1**, wherein the first conveying portion and the second conveying portion obliquely convey the sheet to contact the side edge of the sheet to the reference surface to correct skew feeding of the sheet conveyed by the pair of rotary portions.

7. The sheet conveying apparatus according to claim **1**, wherein the sheet conveying forces of the pair of rotary portions, the first conveying portion, and the second conveying portion are set so as to convey the sheet in the sheet conveying direction in a state that the pair of rotary portions, the first conveying portion, and the second conveying portion nip the same sheet.

8. The sheet conveying apparatus according to claim **1**, wherein

the first conveying portion has a first roller pair which nips the sheet,

the second conveying portion has a second roller pair which nips the sheet, and

the first roller pair receives a leading edge of the sheet conveyed by the pair of the rotary portions in a condition that the rollers of the first roller pair contact each other and the second roller pair receives a leading edge of the sheet conveyed by the pair of the rotary portions in a condition that the rollers of the second roller pair contact each other, and the controller controls the switching portion to release the nip of the sheet by the pair of rotary portions in a state that both the first roller pair and the second roller nip the sheet.

9. A sheet conveying apparatus according to claim **1**, wherein

the first conveying portion has a first roller pair which nips the sheet,

the second conveying portion has a second roller pair which nips the sheet, and

a leading edge of the sheet conveyed by the pair of the rotary portions passes the first roller pair in a condition that the rollers of the first roller pair are apart from each other and a leading edge of the sheet conveyed by the pair of the rotary portions passes the second roller pair in a condition that the rollers of the second roller pair are apart from each other, and the controller controls the switching portion to release the nip of the sheet by the pair of rotary portions in a state that both the first roller pair and the second roller nip the sheet.

10. An image forming apparatus, comprising:

a sheet conveying apparatus including

a pair of rotary portions that nip and convey a sheet in a sheet conveying direction;

a reference surface which is provided along the sheet conveying direction;

a first conveying portion which, obliquely with respect to the sheet conveying direction, conveys the sheet conveyed by the pair of rotary portions so as to contact the side edge of the sheet to the reference surface;

a second conveying portion which is disposed downstream of the first conveying portion in the sheet conveying direction and which, obliquely with respect to the sheet conveying direction, conveys the sheet so as to contact the side edge of the sheet to the reference surface;

a switching portion which switches the pair of rotary portions between a state of nipping the sheet and a state of nip releasing the sheet;

a detecting portion which detects the sheet conveyed by the pair of rotary portions;

a controller which controls to stop the rotation of the pair of rotary portions based on the detection of the detecting portion before the leading edge of the sheet reaches the second conveying portion, and controls the switching portion so that the nip of the sheet by the pair of rotary portions is released after the pair of rotary portions starts rotating and the leading edge of the sheet in the conveying direction reaches the second conveying portion; and

an image forming portion which forms an image on the sheet conveyed by the sheet conveying apparatus.

11. The image forming apparatus according to claim **10**, wherein the sheet conveying forces of the pair of rotary portions, the first conveying portion, and the second conveying portion are set so as to convey the sheet in the sheet conveying direction in a state that the pair of rotary portions, the first conveying portion, and the second conveying portion nip the same sheet.

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